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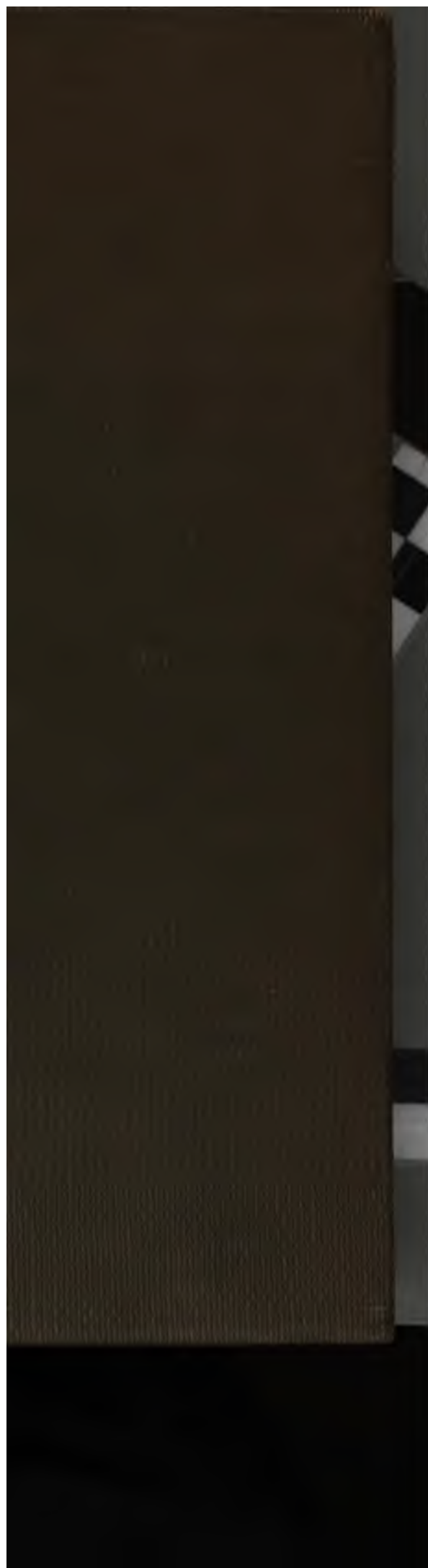
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THE  
IMMEDIATE CARE  
OF THE  
INJURED

BY

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*Second Edition, Thoroughly Revised*

PHILADELPHIA AND LONDON

W. B. SAUNDERS COMPANY

1912

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DEDICATED  
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## PREFACE TO THE SECOND EDITION

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WITH the exhaustion of the first edition of this manual the writer has taken the opportunity to make a thorough revision, correcting such errors as crept into the first edition and changing the manuscript to conform to our latest knowledge of the subjects dealt with. While considerable new matter has been added, at the same time some of the old material has been omitted or condensed so that the book is but little increased in size. The general plan of the work, however, remains unchanged.

In presenting this new edition the writer wishes to again emphasize that *this book is not intended to supplant the physician or surgeon, but is designed solely as a guide in emergencies until the arrival of medical aid or when such aid cannot be procured.*

A. S. M.

222 WEST SEVENTY-SECOND STREET, NEW YORK CITY,  
February, 1912.



## PREFACE TO THE FIRST EDITION

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THE object of this volume is to furnish a reliable guide for those who wish to learn how to render safe and efficient aid in accidents and other emergencies. To make the book useful for laymen the subjects considered have been presented in as simple language as is consistent with clearness, technical terms being omitted as far as possible. Recognizing that illustrations are often of more value than descriptive text in conveying such instruction, a large number—many of them original—have been introduced with a view of affording a clear explanation of points which might otherwise be misunderstood.

For the guidance of those who may be unfortunate enough to be situated where medical aid sometimes cannot be obtained for days or weeks, in addition to the immediate treatment, the subsequent treatment of some of the more important forms of injury has been briefly outlined. In this connection, however, a word of warning is necessary. *First aid should never supersede or take the place of proper medical or surgical attention;* by first aid is meant the *temporary* assistance rendered a sufferer until the arrival of medical aid. To proceed further than this is not only an unwarranted presumption upon the part of the person so doing, but may result in the production of harmful consequences to the injured person. *In all cases a physician should be immediately summoned,* and, in the meantime, the “first aider” should devote his energies to rendering whatever temporary assistance may be within his power.

It will be readily perceived that it is a difficult matter to present such a subject intelligently to those who have no medical knowledge. A previous understanding of the structure and normal workings of the human body is essential for ren-

dering intelligent assistance in cases of injury and sickness. For this reason, in Part I, the anatomy and physiology of the human body has been briefly outlined.

Part II is devoted to bandaging, dressings, practical remedies, etc., their methods of application being thoroughly explained.

In Part III, how to act and what to do in accidents and emergencies are described in detail. In the preparation of the chapter on "The Transportation of the Injured," contained in this section, the drill regulations of the United States Army Hospital Corps have been followed in the main, with some additions; but the subject has been presented in a simple manner to conform to the rest of the text.

Those who desire to properly equip themselves with a practical knowledge of first aid are strongly advised to take up the subjects in the order presented, carefully studying and practising the methods of applying bandages, dressings, etc. A practical application of the knowledge thus gained may then be made in the treatment of special cases as occasions arise. By intelligently following the directions given anyone should be enabled to render valuable aid in alleviating suffering until the arrival of medical assistance and, what is in many cases more important, preventing additional injury being done as the result of willing but ignorant attempts on the part of bystanders to do "something."

The writer takes this opportunity of expressing his thanks to Dr. Percy H. Williams for valuable suggestions made in regard to the text, and to others who have assisted in various ways in the preparation of this book.

A. S. M.

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# IMMEDIATE CARE OF THE INJURED.

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## PART I.

### THE ANATOMY AND PHYSIOLOGY OF THE HUMAN BODY.

#### CHAPTER I.

##### ANATOMY OF THE BONES AND JOINTS.

The human body is composed of solid and fluid constituents. The fluids are the blood, the lymph, the chyle, and the secretions of glands and membranes. They contribute the greater proportion of the total weight of the body,—that is, if it were possible to abstract all the fluids from the body the remaining solid constituents would form only about one-quarter of its original weight.

The solids form the framework of the body and are termed the tissues. Some, as bony tissue, are arranged in hard, solid masses and possess great firmness and strength. Some are elongated, forming threads or fibers, as muscular or nervous tissue, each of which possesses its own peculiar properties. Others may be spread out in thin layers, as the epithelial tissue found upon the surface of the skin and lining the internal organs.

These examples of the elementary tissues, while composed of material peculiar to themselves, seldom exist separately in the body, but are grouped together to form compound tissues and organs differing from each other in structure and uses, such as muscles, nerves, blood-vessels, glands, skin, organs of digestion, etc. Muscles, for example, are composed mainly of



muscular tissue, but also contain nerves, connective tissue, and blood-vessels.



FIG. 1.—Bone tied in knot (Raymond).

In its earliest development the body consists of but a single round cell composed of a jelly-like substance, termed *protoplasm*, in which lies a nucleus. This primary cell soon divides into two cells, and these two into four, and the four into eight, and so on, until a vast number of cells are formed. As this process of development goes on, the cells change in shape, structure, and character. Some remain round, others become oval, spindle-shaped, or star-shaped, according to the structures they are to produce. The different cells next arrange themselves in groups, and so form the elementary tissues of the body. In this way are formed the blood and lymph, bones, cartilage, muscles, nerves, blood-vessels, connective tissue, the skin, and the various organs with special functions.

#### BONE.

Bone forms the hard framework or skeleton of the body. It is composed of animal matter hardened by impregnation with salts of carbonate and phosphate of lime. In the adult, bone consists of two parts of earthy salts to one part of animal matter. In young children, on the other hand, the earthy salts exist in a smaller proportion, with the result that the bone is more flexible and bends rather than breaks when force is applied. In rickets, a disease occurring in childhood from malnutrition, there is a marked deficiency in the earthy salts, so that when the child commences to walk the bones of the legs frequently become bowed from the weight of the body. Bones of old persons contain earthy

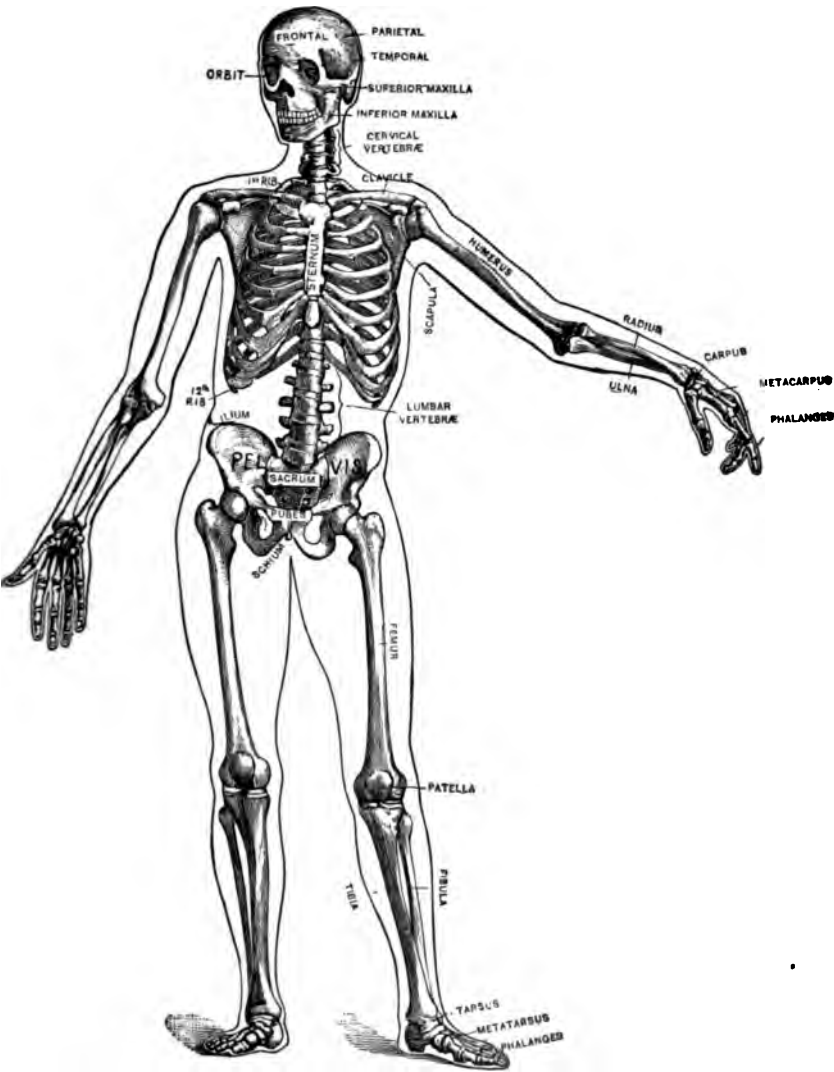


FIG. 2.—The human skeleton.

salts in great excess to animal matter. Such bones are very brittle, and fracture may be produced at times from comparatively slight blows. The earthy salts can be easily dissolved by immersing a bone in dilute hydrochloric acid for a few days. Upon removal, the bone will be found to have lost its brittleness and can readily be bent or twisted (see Fig. 1). The animal matter, likewise, may be abstracted by subjecting the bone to prolonged heat in the presence of an abundance

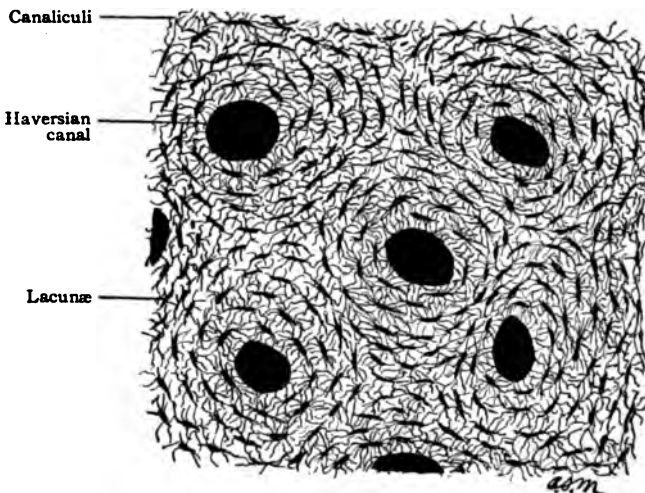


FIG. 3.—Transverse section of bone.

of air. A bone thus treated becomes very brittle and is capable of being easily crushed.

Bones have the function of enveloping and protecting certain parts of the body, as, for example, the chest and skull; of supporting the weight of the trunk, as the bones of the lower extremities; and of acting as levers for locomotion. For these purposes it is essential that the bones should be very strong. As a matter of fact they are among the hardest and toughest structures found in the human body, being able to withstand three times as much pressure as an equal bulk of ash or elm and twice as much as oak. They are also elastic, this being especially marked in the ribs, which permits these bones to withstand severe blows without breaking.

**The Structure of Bones.**—Bone is composed of an outer dense layer of *compact tissue* and an inner porous layer of *spongy* or *cancellous* tissue. These two layers are of practically the same structure, but differ somewhat in their arrangement. On a cross-section of the compact tissue of a long bone there will be seen under the microscope a number of openings surrounded by concentric plates of bone tissue, between which are small dark spaces (Fig. 3). These central openings represent the *Haversian canals*, and the dark spaces the *lacunæ*, which are connected with the Haversian canals and other lacunæ through small thread-like passages termed the *canaliculi*. The Haversian canals give passage to blood-vessels, nerves, and lymphatics, while the lacunæ and canaliculi are the lymph spaces of the bone, serving to convey nourishment to all portions of the bony tissue. Enveloping the exterior of the bone is a layer of fibrous tissue called *periosteum*, which contains many blood-vessels and nerves for the nutrition of the bone.

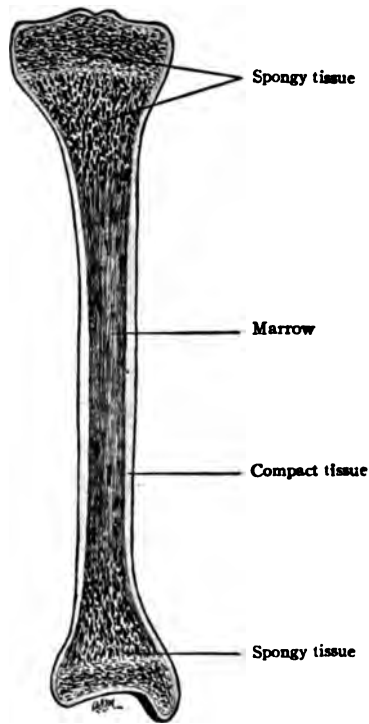


FIG. 4.—Longitudinal section of a long bone.

#### THE SKELETON.

The skeleton is the bony framework of the body. It serves as a foundation and means of attachment for the soft parts, and protects the vital organs. This framework consists of 200

distinct bones held together by ligaments. The point of union of two bones is termed a *joint*, and, at points where two bones meet or play upon each other, their surfaces are covered with cartilage. Four varieties of bone enter into the formation of the skeleton,—long, short, flat, and irregular bones.

*Long bones*, such as those of the extremities, serve to support the weight of the trunk and act as levers for the movements of the body. Such bones consist of a cylindrical shaft and two

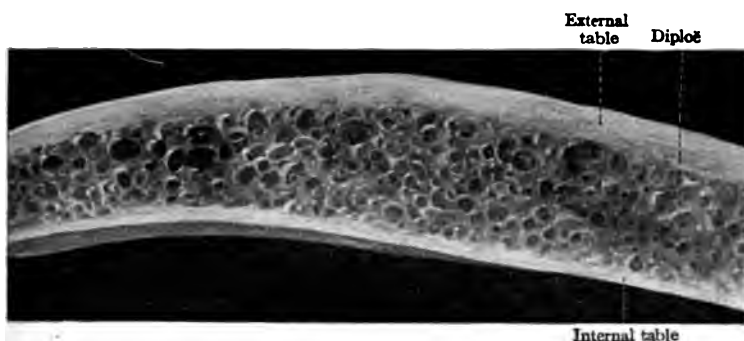


FIG. 5.—A cross-section of a bone of the skull (Schultze and Stewart).

extremities. The extremities are broader than the shaft, thus permitting the bones to be more securely united to each other. They are composed of spongy tissue covered with a very thin layer of compact tissue. The shaft is hollow and is filled in its center with *marrow*, while its walls are composed of compact tissue, an anatomical arrangement that combines lightness with great strength.

*Short bones*, like those in the wrist or ankle, are intended for strength and compactness in regions not requiring extensive motion. They are composed of spongy tissue covered with a shell of compact tissue. In the wrist the bones are arranged in parallel rows united by ligaments.

*Flat bones*, such as form the head and sternum, serve more as a protection for the parts they inclose and to provide a broad surface for muscular attachment than for strength. They consist of two compact layers inclosing spongy tissue. In the skull

the compact layers are named inner and outer tables, while the spongy layer is termed the *diploë* (Fig. 5).

*Irregular bones*, such as the vertebræ and the bones of the face, have the same structure as other bones, but on account of the lack of definite shape cannot be grouped in any of the other three classes.

For descriptive purposes the skeleton is divided into the head, the trunk, and the extremities.

#### THE HEAD.

The bones composing the head, or skull, with the exception of the lower jaw, are closely united together and form a solid case inclosing the brain. The irregular lines marking the junction of the different bones are spoken of as *sutures*. These sutures are not completely solidified in infancy and may be mistaken for fractures, so one should be familiar with their exact location. The upper portion of the skull is called the *vertex*, or vault, while the lower part is termed the *base*; the front portion is termed the *sinciput*, and the back part the *occiput*. In the base are numerous openings, or foramina, which transmit blood-vessels and permit the exit of the cranial nerves. The largest of these openings, the *foramen magnum*, gives passage to the spinal cord.

The thickness of the skull is less in women than in men. It also varies in different races, being very thick in the negro. The individual skull is not of equal thickness in all regions; yet, in spite of this, the weight is so evenly adjusted that the head maintains its balance upon the spinal column. The thickest part of the skull is in the region of the occiput; the thinnest over the temporal bones; hence, fractures from blows received directly over the back of the head are rare. All the cranial bones are comparatively thin, yet their arched shape adds greatly to their strength and stability and serves to distribute the force of a blow over a considerable area. Furthermore, many of them are reinforced by ridges extending along the

internal surface, so that it requires much more force to produce a fracture than would at first be supposed.

The head may be described as the *cranium*, and the *face*.

The **Cranium** is composed of eight bones—the *frontal bone*, which forms the forehead; the two *parietal bones*, which form the top and upper sides of the head; the two *temporal bones*, which form the lower sides of the head and also a part of

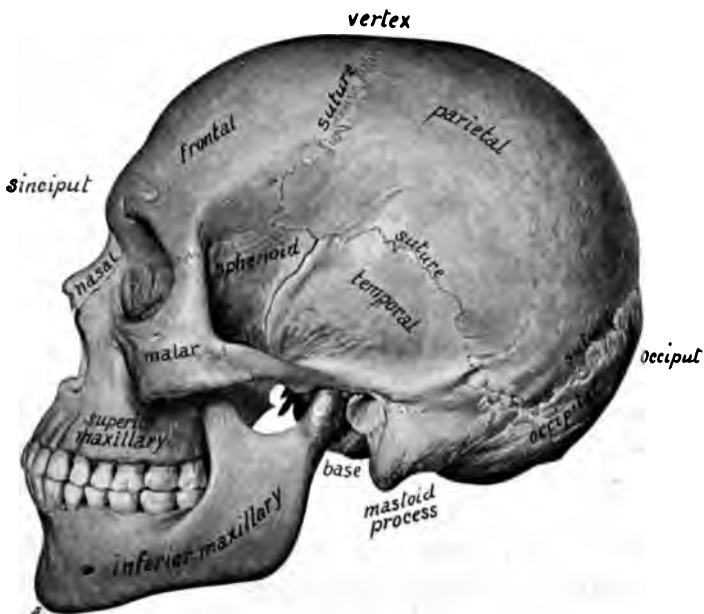


Fig. 6.—Side view of the skull (Sobotta).

the base of the skull; the *occipital bone*, which forms the back of the head and posterior portion of the base of the skull; and the *ethmoid* and *sphenoid* bones, which enter into the formation of the floor or base of the cranium.

The **Face** is composed of fourteen bones. Half of these enter into the formation of the nose. The two *nasal* bones form the bridge of the nose; the *vomer* divides the nose into two halves; the two *turbinate* bones line its interior; and the two

small *lachrymal* bones enter into the formation of a small part of the nose and also contribute to the orbit. The seven remaining bones of the face are the two *malar* bones, which form the prominences of the cheeks; the two *palate* bones, which form a part of the roof of the mouth; the two *superior maxillary* bones,



Fig. 7.—Front view of the skull (Sobotta).

which form the upper jaw and greater part of the roof of the mouth; and the *inferior maxillary* bone, or lower jaw.

The *hyoid* bone lies in the neck about on a level with the lower border of the lower jaw. It is a small U-shaped bone giving attachment to the muscles of the tongue and to the ligaments of the larynx. Through pressure applied to the neck in attempts at strangulation this bone is sometimes fractured.



## THE TRUNK.

The trunk, composed of the spine, thorax, and pelvis, is that portion of the bony skeleton which supports the head and connects the upper and lower limbs. It protects the spinal cord and vital organs of the chest and abdomen.

The **Spine**, or vertebral column, consists of a number of small, irregular bones called *vertebræ*. The *vertebræ* are joined together by ligaments to form a long, flexible column. In this column lies the spinal cord, and upon the upper end of it

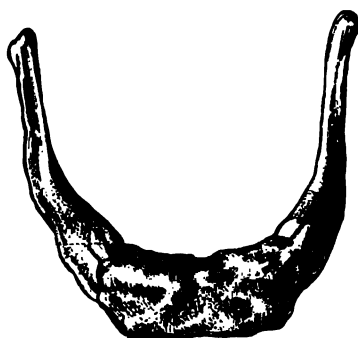


FIG. 8.—The hyoid bone (Toldt).

rests the skull. In front each vertebra is composed of a solid portion, the *body*, and behind consists of an *arch*, or *foramen*, through which passes the spinal cord. The *vertebræ* are separated from each other by discs of cartilage which act in the capacity of springs and tend to break the force of any sudden jar, which might otherwise be transmitted to the head. These intervertebral discs are so soft and elastic that the weight of the body pressing upon them during the day causes them to be somewhat compressed, and so diminishes slightly the height of the person. After a night's rest the full height is again restored.

There are 33 *vertebræ* in the spine. Seven of these enter into the formation of the neck—*cervical vertebrae*; 12 enter into

the formation of the back—*dorsal vertebræ*; 5 enter into the formation of the loins—*lumbar vertebræ*; 5 form the *sacrum* and 4 form the *coccyx*. The sacral and coccygeal vertebræ are at first distinct bones, but in adult life the intervening cartilages become ossified or hardened and they thus form by their union two separate bones—the sacrum and the coccyx.

There are three curves in the spinal column: forward at the neck, backward in the region of the chest, and forward again in the lumbar region. These curves are produced by differences in the thickness of the intervertebral cartilages and also by variations in the thickness of the separate vertebræ. In certain

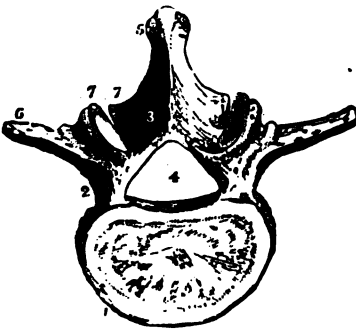


FIG. 9.—A type of vertebra: 1, Body; 2, pedicle; 3, lamina; 4, spinal foramen; 5, spinous process; 6, transverse process; 7, articular process (Leidy).



FIG. 10.—The spinal column (Church).

diseases of the spine the curves may be abnormally increased, an increase of the backward curvature, for example, producing hump-back.

The **Thorax**, or chest, may be described as a cage formed by the 12 dorsal vertebræ behind, the 12 ribs at the sides, and the sternum in front. It contains and protects the heart and lungs.

**The Ribs.**—There are 12 ribs on each side, and they form the main part of the chest wall. The ribs are capable of being moved up or down by the attached muscles, and in this way the capacity of the chest is increased or diminished during respira-

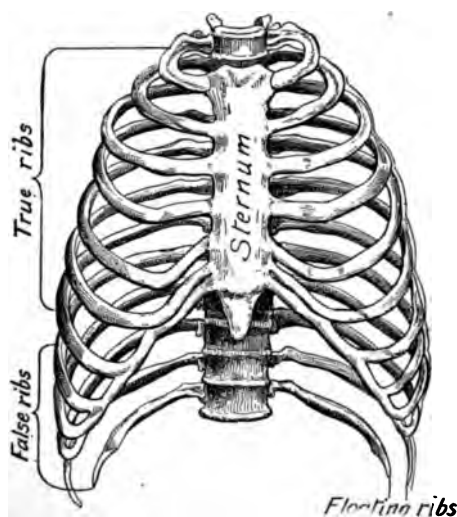


FIG. 11.—Thorax (anterior view) (Ingals).

tion. The 7 upper ribs are spoken of as the *true ribs*. They are attached behind to the dorsal vertebræ and in front to the sternum by means of intervening cartilages. The remaining 5 are termed *false ribs*. They are all attached behind to the dorsal vertebræ, but in front each of the 3 upper ones is attached to the cartilage of the rib above, instead of to the sternum, while the remaining two have no attachment in front, and are known as *floating ribs*.

The **Sternum**, or breast-bone, is a flat bone, about six inches long, forming the front wall of the chest. It has been compared

to a dagger in shape. Above it is broad and shows a depression on each side into which fit the collar-bones; below it tapers to a point. Its sides give attachment to the cartilages of the true ribs.

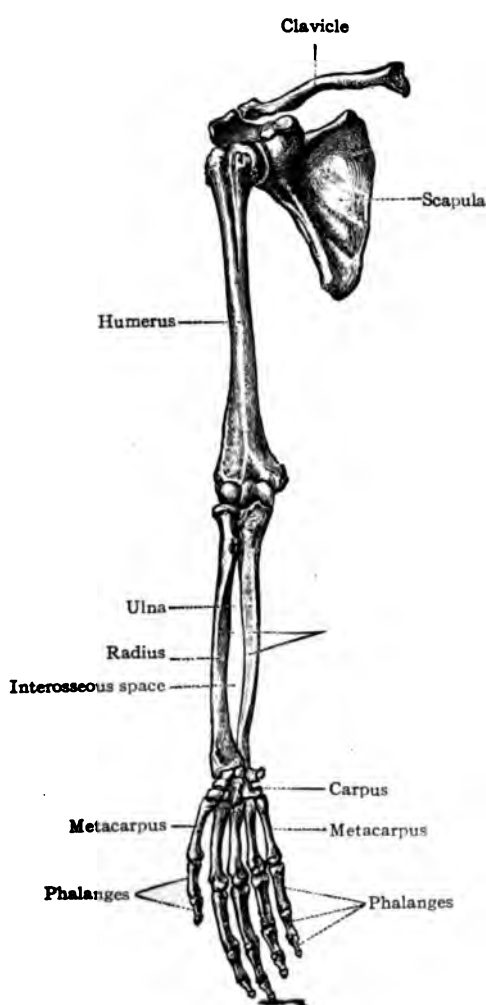


FIG. 12.—Bones of the upper extremity (Toldt).

Penetrating wounds in the region of the sternum are very dangerous, as the heart and great blood-vessels lie almost immediately behind it.

The **Pelvis**, so called on account of its resemblance to a basin, is the bony structure serving to connect the lower extremity with the spinal column. It is composed of 4 bones—the sacrum and coccyx behind, and the 2 innominate bones in front which form its anterior and side walls.

#### THE EXTREMITIES.

The **Upper Extremity** consists of 32 bones. The arm, forearm, and hand form the upperlimb proper, while the clavicle and scapula form the *shoulder-girdle* which serves to connect the arm to the trunk.

The **Clavicle**, or collar-bone, is a curved bone shaped somewhat like the letter *f*, lying just above the first rib. It



FIG. 13.—The clavicle, or collar-bone.

articulates with the sternum internally and with the scapula externally, and serves to support the upper limb.

The **Scapula**, or shoulder-blade, is a large, flat, triangular bone, situated back of the chest wall, its broad surface serving for the attachment of muscles passing between it and the chest and arm. It is connected in front with the sternum by means of the clavicle. On its posterior surface is a large ridge, termed the *spine*, which arches forward and terminates in a flat projection overhanging the shoulder-joint, known as the *acromion process*. At its upper and anterior angle is a cup-shaped depression, called the *glenoid cavity*, into which the head of the humerus fits, forming the shoulder-joint.

The **Humerus**, or arm-bone, is the longest and largest bone of the upper extremity. Its upper end consists of a *head* and an *anatomical neck*. Just below the neck are two rough promi-

nences—the *tuberosities*. The head articulates with the glenoid cavity of the scapula, and with it forms the shoulder-joint. The lower end of the bone is somewhat flattened from before backward and spread out from side to side, and, curving slightly forward, articulates with the bones of the forearm, forming the elbow-joint. The portion of the shaft of the bone immediately below the tuberosities is called the *surgical neck*, from the fact that it is frequently the site of fracture.

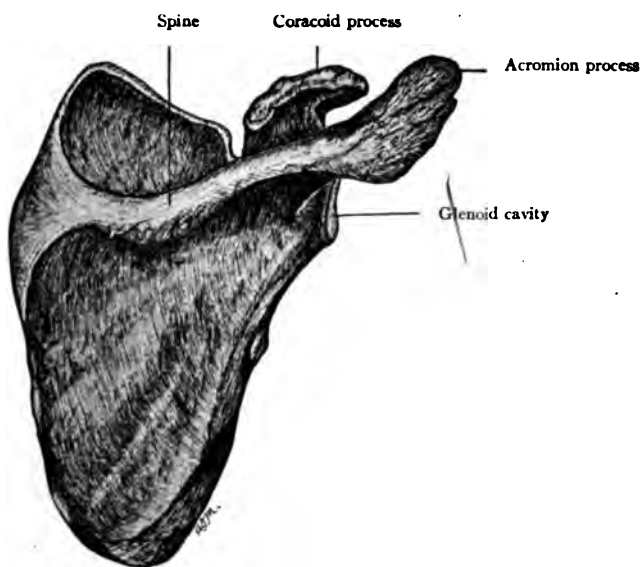


FIG. 14.—The scapula, or shoulder-blade.

The **Forearm** is composed of the radius and the ulna.

The **Radius** lies upon the outer side of the forearm. Its upper extremity is small and forms but a small portion of the elbow-joint. The lower extremity, however, is large and forms the greater part of the wrist-joint.

The **Ulna** lies upon the inner side of the forearm, parallel with the radius. Its upper extremity contributes largely to form the elbow-joint. Extending up and behind the joint is a

process of the ulna which forms the point of the elbow, known as the *olecranon*, or "funny-bone."

The **Hand** is divided into 3 portions: the carpus, which forms the wrist and consists of 8 bones—the *scaphoid*, the

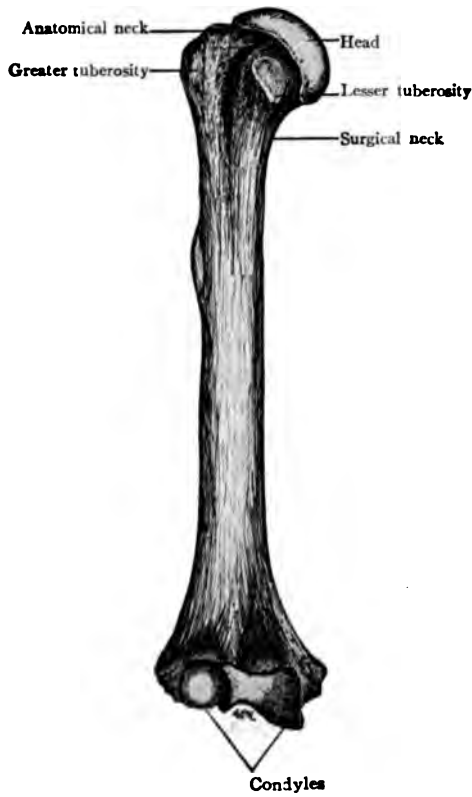


FIG. 15.—The humerus, or arm-bone.

*semilunar*, the *pisiform*, the *unciform*, the *cuneiform*, the *os magnum*, the *trapezoid*, and the *trapezium*; the metacarpus, consisting of 5 bones; and the phalanges, or finger-bones, 14 in number, 3 for each finger and 2 for the thumb.

The **Lower Extremity** consists of 31 bones which form the

thigh, leg, and foot, corresponding to the arm, forearm, and hand of the upper extremity. The lower extremity is connected with the trunk through the os innominatum, or hip-bone, which forms the so-called *pelvic-girdle*.

The **Os Innominatum**, meaning unnamed bone because of

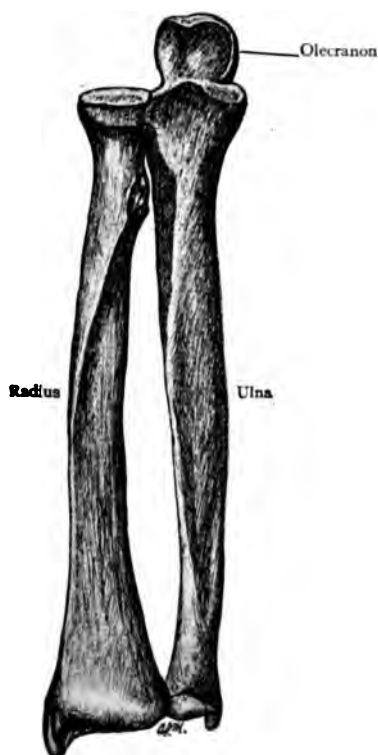


Fig. 16.—The bones of the forearm.

the lack of resemblance it bears to any known object, is very irregular in shape, and with its fellow of the opposite side forms the front and side walls of the pelvis. It consists of 3 portions—the *ilium*, the *ischium*, and the *pubes*. Above, the bone flares out into a flat, broad surface, the upper border of which is known as the *crest of the ilium*. The anterior portion



of this border is called the *anterior superior spine of the ilium*, a point from which measurements are taken in estimating the shortening in a fracture of the thigh. On the outer surface of the bone is a depression—the *acetabulum*—into which the head of the femur fits. The point of meeting of the two hip-bones in front is known as the *symphysis pubis*.

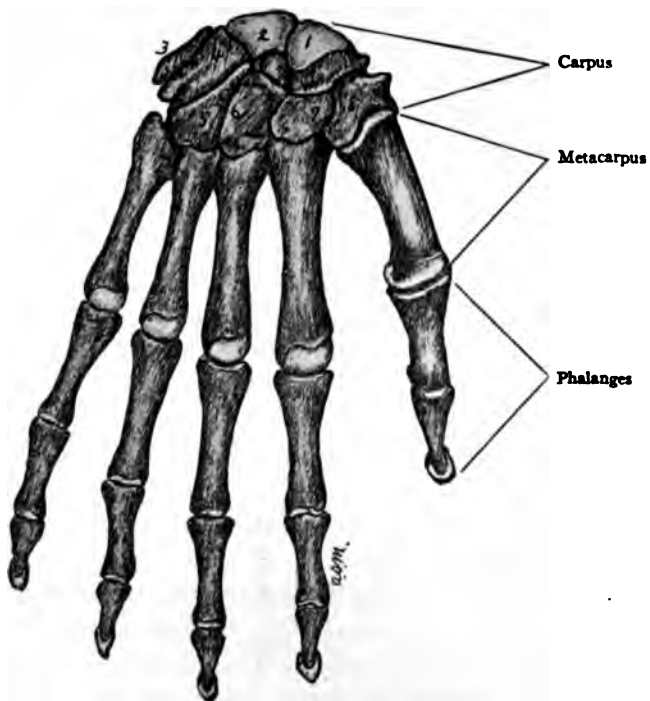


FIG. 17.—Bones of the right hand, dorsal surface. 1, Scaphoid; 2, semi-lunar; 3, pisiform; 4, cuneiform; 5, unciform; 6, os magnum; 7, trapezoid; 8, trapezium.

The **Femur**, or thigh-bone, is the longest, largest, and strongest bone in the body. Upon the upper end of the bone is a round, knob-like projection known as the *head* of the femur, which articulates with the acetabulum of the innominate bone to form the hip-joint. The head is separated from the shaft

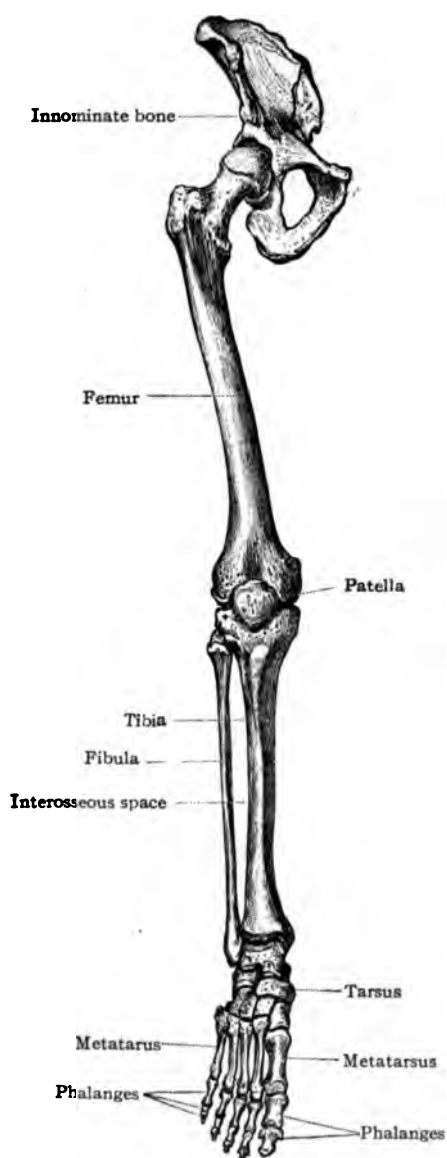


FIG. 18.—Bones of the lower extremity (Toldt).

of the bone by a constricted portion, known as *the neck*. The neck serves to keep the thigh-bones separated from the trunk, thus preventing the two bones from interfering during the act of walking. The neck of the femur also has to bear the whole weight of the head, trunk, and upper extremities, and its structure is well adapted for this purpose, being composed of a layer of compact tissue externally, and internally of very dense cancellous tissue arranged in arches, which add greatly to the strength of the bone. In old age the bony structure of the neck

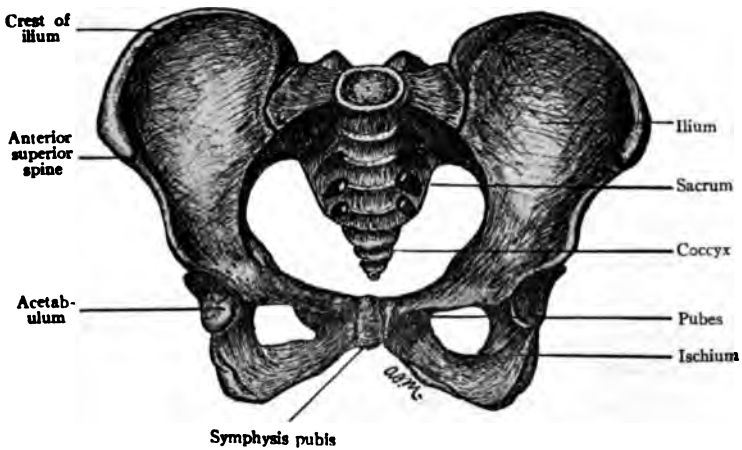


Fig. 19.—The pelvis.

of the femur becomes weakened and more brittle, and is easily fractured. Below the neck, on the outer and inner sides of the bone, are two rough eminences for the attachment of muscles known respectively as the *greater* and *lesser trochanters*. The lower extremity of the femur is broad and is divided by a depression into two rounded portions, termed the *condyles*, which rest upon the tibia and enter into the formation of the knee-joint.

The **Leg** consists of three bones—the *tibia*, the *fibula*, and the *patella*.

The **Tibia**, shin, or flute-bone, lies upon the front and inner side of the leg, being next to the femur in size and length. Its upper end is large and expanded into a broad surface known as the *tuberosities*, which support the condyles of the femur and

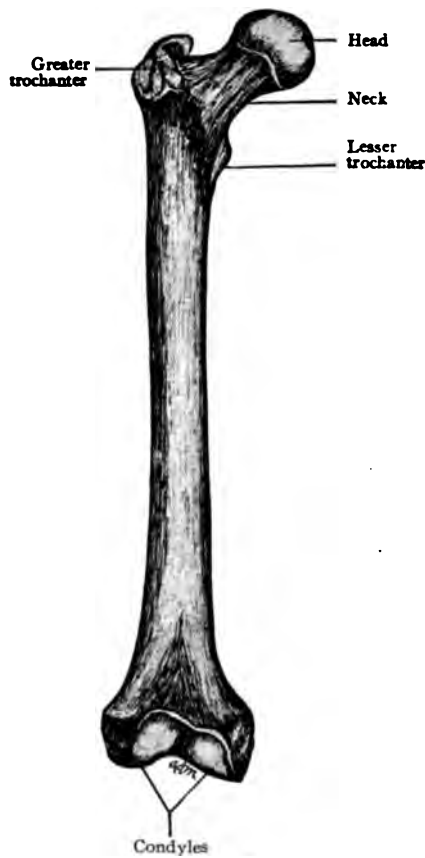


FIG. 20.—The femur, or thigh bone.

with them form the knee-joint. The lower end is much smaller than the upper, and, on its inner side, the bone extends downward in a projection known as the *inner malleolus*.

The **Fibula**, or splint-bone, is the slender bone lying upon

the outer side of the leg. Its upper end does not reach as high as the tibia, nor does it enter into the formation of the knee-joint. The lower extremity, the tip of which is known as the *outer malleolus*, reaches below the level of the tibia and enters into the formation of the ankle-joint.

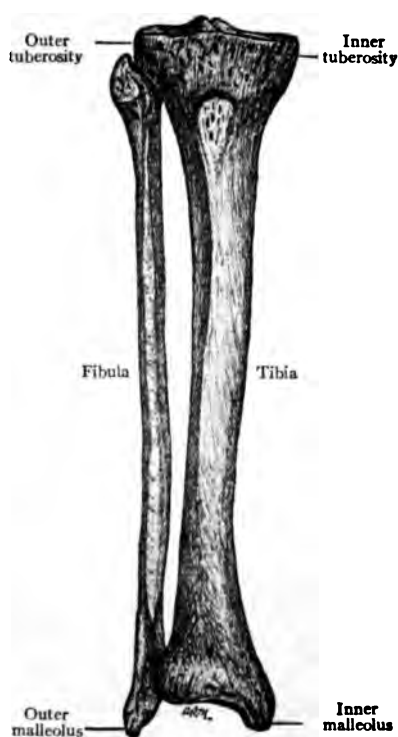


FIG. 21.—The bones of the leg.

The **Patella**, or knee-cap, is the small, flat, somewhat triangular bone in front of the knee-joint.

The **Foot** consists of 26 bones divided into three portions—the *tarsus*, *metatarsus*, and *phalanges*. The bones of the tarsus, 7 in number, form the ankle-joint. They are the *astragalus*,



FIG. 22.—The patella, or knee-cap.

the *os calcis*, the *navicular* or *scaphoid*, the *cuboid*, the *internal cuneiform*, the *middle cuneiform*, and the *external cuneiform*; the largest of these, the *os calcis*, forms the heel. The metatarsus, or instep, is composed of 5 bones, while the 14 remaining bones form the phalanges or toes.

### THE JOINTS.

The points of union of the different bones forming the skeleton with one another are termed joints, or articulations.

The tissues of which a joint is composed are bone, cartilage, ligaments, and synovial membrane.

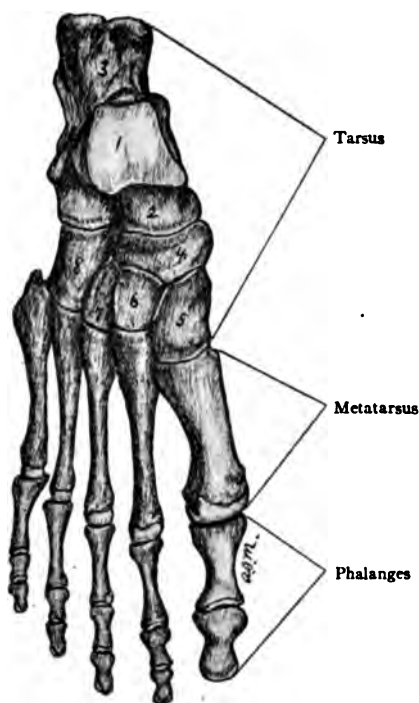


FIG. 23.—Bones of the right foot. 1, Astragalus; 2, head of the astragalus; 3, os calcis; 4, navicular; 5, internal cuneiform; 6, middle cuneiform; 7, external cuneiform; 8, cuboid.

**Cartilage.**—The ends of the bones forming the joints are covered with a smooth, somewhat elastic and very dense tissue, not as hard as bone, termed *cartilage*, or “gristle.” It has a pearly blue color, is not supplied with blood-vessels or nerves, and is thickest over the parts of the bone where the pressure is greatest. Cartilage provides the articulating bones with

smooth surfaces for motion upon one another without friction; being elastic tissue, it further serves as a buffer against sudden shocks or jars.

Other forms of cartilage are also present in the body, such as the cartilages of the larynx and the intercostal cartilages between the ribs and sternum.

**Ligaments** are strong, inextensible bands of fibrous tissue having a silvery white appearance. They are very flexible

and so allow free motion in the joints; at the same time they are very tough and inelastic, thus serving to hold the bones of a joint in close apposition.

As the result of great force acting upon a joint, the ligaments may become stretched or torn, producing the common condition of a *sprain*; if the injury is severe enough to allow the articular surfaces to become displaced, the injury is known as a *dislocation*.



FIG. 24.—The hip-joint, showing the ligaments.

**Synovial Membrane** is a very thin and delicate layer of connective tissue lining that

part of the internal surface of the ligaments contained within the joint but not covering the articular surfaces of the bones. This membrane secretes a thick, transparent, slightly reddish fluid which acts as a lubricant for the joint surfaces.

Following an injury to a joint the synovial membrane may become inflamed and the synovial fluid be greatly increased in amount,—a condition called *synovitis*. Such a condition occurring in the knee-joint, for example, results in what is commonly known as “water on the knee.”

**Varieties of Joints.**—There are three chief varieties of

joints—immovable joints, joints with limited motion only, and freely movable joints.

**Immovable Joints.**—In immovable joints, as seen in the articulations between the bones of the skull, the bones are, as a rule, firmly united together by immediate contact of bony surfaces, and thus form solid articulations.

**Joints with Limited Motion.**—Other joints have a limited motion only, as, for example, the joints of the vertebral

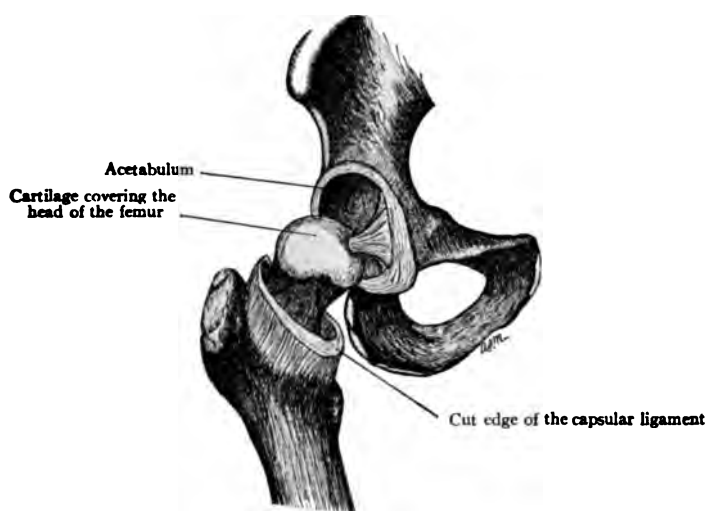


FIG. 25.—The hip-joint laid open.

column, where the vertebræ are firmly united together by thick ligaments, plates of very tough and elastic fibro-cartilage intervening, which allows but slight motion between the individual vertebræ, yet permits considerable movement of the column as a whole. The joints between the bones of the pelvis are of this same variety.

**Freely Movable Joints.**—In all perfect or freely movable joints the opposed bony surfaces are expanded, covered with cartilage, and held together by stout ligaments. These liga-



ments may be arranged as distinct bands which unite the bony surfaces, or else they may exist as a complete sac or capsule which surrounds the joint. The interior of such a joint is lined with synovial membrane.

Movable joints are further subdivided into gliding, ball-and-socket, hinge, and pivot-joints.

*Gliding-joints* are found between the small bones of the wrist and ankle and allow but slight motion.

*Ball-and-socket joints* permit the freest movement in all directions. They consist of a cup-like cavity into which fits a round head. The hip- and shoulder-joints are examples.

*Hinge-joints* are found in the elbow, knee, fingers, and toes. Motion is possible in two directions only: backward and forward.

*Pivot-joints* permit rotation, as, for example, in the joints between the radius and ulna.

**Kinds of Movement in Joints.**—The following movements are possible in joints, depending on the shape of the articulating surfaces: flexion, extension, abduction, adduction, circumduction, and rotation.

A limb is *flexed* when an angle is formed in it through the bending of a joint; *extended* when this angle is decreased or obliterated. A limb is *abducted*\* when it is drawn away from the middle line of the body, *adducted* when it is brought to the middle line. *Circumduction* is a combination of movements by which a bone describes a cone-like figure, the apex of which corresponds to a joint, and the base to the free extremity of a bone. *Rotation* is the movement of a bone about a longitudinal axis.

\* In the hands and feet the middle phalanx is taken as the central line, hence the thumb would be abducted when drawn away from the middle finger.

## CHAPTER II.

### THE ANATOMY OF THE SOFT PARTS.

#### MUSCLES.

Muscular tissue, or the flesh, as it is more commonly called, forms a covering for the bony skeleton and gives to the body its contour or shape. It also contributes to the formation of certain organs and viscera of the body. In thin persons the outline of the individual muscles can be easily distinguished beneath the skin, but in stout people the spaces between the muscles become so well filled with fat that the outlines of the muscles are obliterated, and the whole body has a more rotund appearance.

Muscles are simply masses of individual muscle fibers. The separate fibers are surrounded by connective tissue and united, together with their blood-vessels, into bundles. These

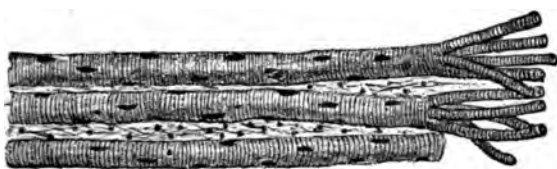


FIG. 26.—Voluntary muscle fibers (Leroy).

bundles of fibers, in turn, are bound together to form the different muscles which vary in length, breadth, and thickness.

Two varieties of muscles exist in the body: *voluntary* or *striped* and *involuntary* or *unstriped muscles*.

**Voluntary Muscles** are those which can be made to contract through the power of the will. This is made possible by means of the nerves which supply such muscles, each muscle being in communication with the brain or the spinal cord through a separate nerve fiber. These muscles may be attached to the bones, cartilages, ligaments, or skin, either



FIG. 27.—The superficial muscles of the body.

directly or by cords of white fibrous tissue, the *tendons*. Voluntary muscles consist of a large expanded portion, or *belly*, and two extremities, spoken of as the *origin* and *insertion*. The origin of a muscle is its attachment to a fixed or stationary bone, while the insertion refers to its attachment to a movable bone.

**Involuntary Muscles** act independently of the will and without our being conscious of their action. They are not attached to bones, but are present in the arteries and veins, intestinal canal, and other internal organs. The fibers of the involuntary muscles are paler in color than those of the voluntary variety and are not arranged in such thick bundles, but form thin bands around the hollow organs.

**The Function of Muscle.**—Every fiber composing a muscle has the property of shortening in length and increasing in thickness. This is spoken of as the *contraction* of a fiber, and is a property possessed by all muscular tissue to a greater or less extent. When a muscle contracts, its two ends and whatever is attached to these ends are brought nearer together. In this way the bones of the body are made to move, and the body itself can move from place to place and, through its limbs, can perform such work as lifting, carrying, pushing, etc. This is possible because for every muscle which acts upon a limb from one direction there is another muscle with a directly opposite action,—for example, there are muscles on one side of a limb which bend it, while upon the other side are muscles which extend or straighten the limb. Without this antagonistic action, so to speak, of the muscles the limbs would be utterly useless, and the body would fall in collapse, as the upright position assumed by the human skeleton is maintained simply through the well adjusted and combined action of many different muscles. The action of the different muscles upon the bones is well illustrated in the case of a fractured limb. One fragment of bone will be drawn upon by a certain set of muscles, and the other fragment will be pulled in another direction by other muscles. The result is that,

aside from the excessive pain, the limb will be distorted in shape.

The action of the muscles upon the limbs producing locomotion and work is, however, not their only use. Breathing is produced by certain muscles acting upon the chest. Speech is the result of the action of the muscles of the throat, tongue, and larynx. There are small muscles in the orbits attached to the eyes which move the eyeballs, and seeing in different directions is possible. Certain of the muscles in the face produce the expression of emotion; muscles acting upon the mouth, for example, produce the expression of laughing or the appearance of sorrow; others wrinkle the forehead, giving the characteristic appearance of anger. The involuntary muscles in the stomach and intestines contract and propel the food along the alimentary canal. Besides these, many other examples of the varied functions of muscles might be given.

#### TENDONS.

The tendons are bluish white, glistening cords of fibrous tissue by means of which the muscles are united to the bones. They may be round or flat, and vary in length and thickness, the *tendo Achillis*, attached to the heel, being the largest in the body. The tendons are inelastic and cannot contract or pull upon the bones like muscles; in this respect they may be compared to ropes, which are useless in themselves for moving a body unless some power be applied to them. In the case of the tendons, this necessary power is supplied by the contracting muscles.

#### CONNECTIVE TISSUE.

Surrounding the muscles and organs of the body is a delicate network or mesh of fibrous tissue in which are imbedded fat cells or drops of liquid fat. This is called the *connective tissue*. It not only invests the entire muscular structure of the body with a covering, but it binds the muscles into groups and also dips down between individual muscles,

forming a separate sheath or covering for each. In like manner sheaths for the vessels and nerves are formed.

More superficially, or immediately beneath the skin, the connective tissue is found as a continuous layer known as *subcutaneous tissue*. This layer varies greatly in thickness in different individuals and has several important functions,—it gives fullness to the body; it serves as a medium for the passage of the superficial blood-vessels and nerves; it acts as a protection for the subjacent parts; it permits the skin to move freely over the underlying tissues; and it aids in maintaining the bodily warmth.

#### THE SKIN AND APPENDAGES.

The **Skin**, or integument, forms the external or outermost covering of the body. The appendages are the hair and

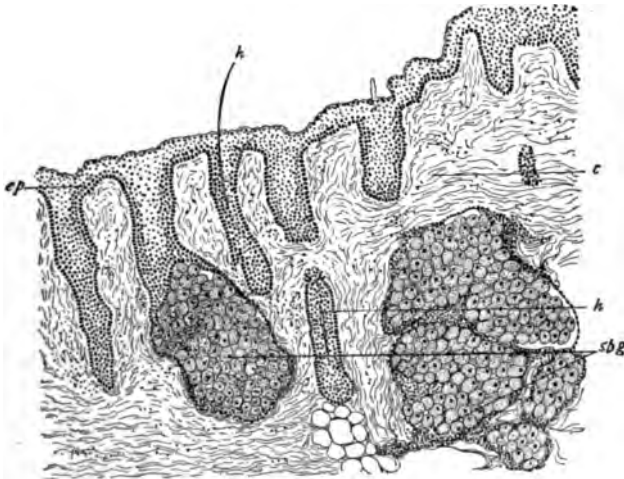


FIG. 28.—Vertical section of skin: *sbg*, Sebaceous glands; *ep*, epidermis; *h*, hair; *d*, derma (Fox).

nails. The skin is the special organ for the sense of touch, and it also performs the important function of an excretory organ. It consists of an external layer, the epidermis, and a deep layer, the dermis, or true skin.

The **Epidermis** is composed of layers of epithelial cells which form a horny covering for the true skin. There are neither blood-vessels nor nerves in this layer, and, if cut, it neither bleeds nor causes pain. The sense of touch lies in the papillæ, or nerve endings, situated in the true skin.

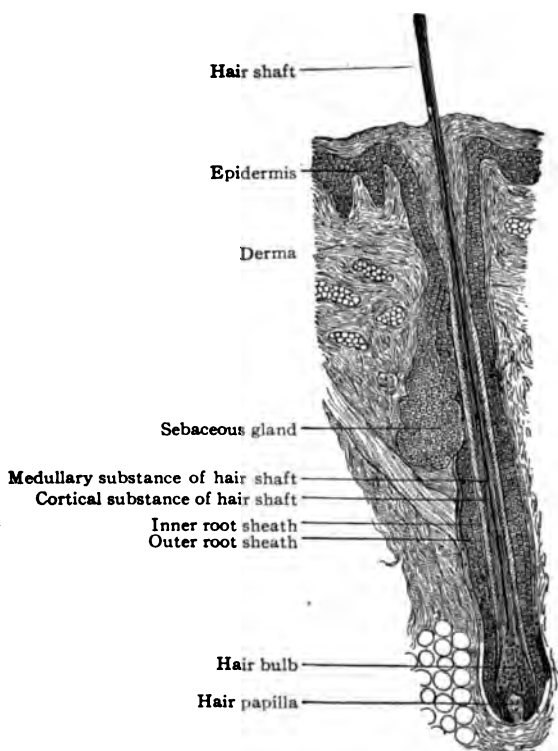


FIG. 29.—Section through hair and follicle (Fox).

The **Dermis** consists of a fibrous matrix in which are imbedded nerves, blood-vessels, sweat glands, hair, hair follicles, and sebaceous glands, and upon its surface are a great number of small, highly sensitive projections, termed *papillæ*.

The *sweat glands* open upon the surface of the skin by small ducts, commonly called *pores*. They have the function of separating waste materials and fluids from the blood and

excreting them in the form of perspiration. There are over two thousand of these glands in a square inch of skin.

The *sebaceous glands* open upon the surface of the skin, usually at the base of a hair follicle, and secrete a thick fatty material which furnishes oil for the hair and the skin. If the skin is not frequently bathed, the ducts of these glands become plugged with this oily secretion, and dirt readily collects in their openings, giving to the skin the appearance of being studded with small black specks. The sebaceous glands about the face are often thus affected.

The **Nails** are layers of modified epidermis, which become converted into horn as they grow, and finally form a single solid plate of horny material. The true skin beneath likewise becomes modified and forms the *matrix*, or nail bed.

**The Hair.**—The whole surface of the body, except the palms of the hands and the soles of the feet, is covered with a very fine down or, in some regions, by fully developed hair. A hair consists of a long shaft having its origin in a hair sac or hair follicle, and is, like a nail, composed of a modified form of epidermis. Small, delicate, involuntary muscles are attached to these follicles or sacs, and, when they contract, raise the hair to a perpendicular position. This effect is produced under the influence of cold or fright, and gives rise to what is called “goose flesh” or “hair standing on end.”

#### MUCOUS MEMBRANE.

At the edges of the openings leading to or from the interior of the body the skin ends and its place is taken by a soft, reddish tissue, the *mucous membrane*, which forms a smooth, velvety, and very vascular lining for the interior of the respiratory, digestive, and urinary tracts. The surfaces of all mucous membranes are moistened with a thick secretion, called *mucus*.

#### SEROUS MEMBRANES.

Serous membranes are thin, glistening layers of tissue which form a lining for some of the cavities of the body and a



covering for their contained organs. That lining the abdomen and surrounding its contents is called the *peritoneum*; that lining the chest and surrounding the lungs the *pleura*; and that surrounding the heart the *pericardium*. There is a small quantity of fluid secreted by such membranes, sufficient to moisten their surfaces.

#### GLANDS.

Scattered all through the body are collections of cells, abundantly supplied with blood-vessels, termed *secretory glands*, whose function is to abstract from the blood certain materials and manufacture from them new substances. Examples of such cells are found in the glands of the alimentary tract which secrete the digestive fluids.

Some glands simply excrete waste materials which are of no further use to the body. They are known as *excretory glands*, such as the sweat glands of the skin, and the kidneys.

Most of the secreting glands have a duct or small tube leading from them, through which their secretions are discharged and conveyed to the parts they supply.

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## CHAPTER III.

### THE THORACIC AND ABDOMINAL CAVITIES AND THEIR CONTENTS.

The trunk of the body contains in its interior a large cavity divided into two portions by the diaphragm muscle. The upper third of this cavity is called the thorax, or chest, while the lower two-thirds is known as the abdomen, or belly.

#### THE THORACIC CAVITY.

The thorax is an irregular, cone-shaped cavity, with the apex above and the base below, bounded behind by the twelve dorsal vertebræ, laterally by the twelve ribs and the intercostal muscles, and in front by the sternum and costal cartilages. Below, it is separated by the diaphragm from the abdominal cavity, and above it is closed in by the muscles of the neck. The dorsal vertebræ project into the cavity from behind, partially dividing it into two compartments.

**Contents of the Thorax.**—The thoracic cavity contains and protects the lungs, heart, esophagus, and trachea.

The **Lungs**, two in number, termed the right and left lung, lie upon either side of the spinal column. Each is contained in a closed sac of serous membrane, the *pleura*.

The apex of each lung rises into the neck for a distance of 1 1/2 inches above the first rib, consequently the lungs may be injured from wounds situated low down in the neck. On the sides, the lower borders of the lungs extend as low as the eighth rib, while behind the lower border corresponds to about the tenth rib. Stab wounds of the chest, at or a little above these levels, would therefore result in injury to the lungs; while, if the penetrating instrument extended deep enough, it would also enter the abdominal cavity, because the

under surfaces of the lungs, resting upon the diaphragm, are concave, and the upper limit of the abdominal cavity is on a higher plane than the lower edges of the lungs.

The **Heart** is situated in the lower and front part of the thorax between the two lungs, the greater portion of it lying upon the left side of the chest. It, too, is surrounded by a closed membranous sac, the *pericardium*.

The heart occupies a position roughly represented upon the chest by a right-angled triangular area, the apex of which is situated at the second rib and its base at the sixth rib. This area near the base measures about 5 inches across, becoming smaller toward the apex, and it extends about 3 1/2 inches to the left, and 1 1/2 inches to the right, of the median line of the sternum. While a penetrating wound near the middle of the chest above the second rib would thus escape the heart, it might injure the large vessels which lead from it.

The space in the median line not occupied by the heart and lungs is called the *mediastinum*, and contains the *trachea*, or windpipe, the *esophagus*, or gullet, the great vessels of the heart, and some nerves.

#### THE ABDOMINAL CAVITY.

The abdominal cavity, much larger than the thorax, is the barrel-shaped portion of the trunk lying between the diaphragm above and the pelvis below, the part within the pelvis being termed the *pelvic cavity*. Behind it is bounded by the spine, laterally and in front by the muscular wall extending between the thorax and the pelvis. It is lined by a thin serous membrane, the *peritoneum*.

**Contents of the Abdominal Cavity.**—The abdomen contains a part of the urinary system and nearly all of the digestive organs, the greater part of the cavity being occupied by the closely packed intestines.

**The Liver.**—Upon the right side of the abdomen just beneath the diaphragm lie the liver and *gall bladder*. The upper surface of the liver reaches as high as the fifth rib, thus

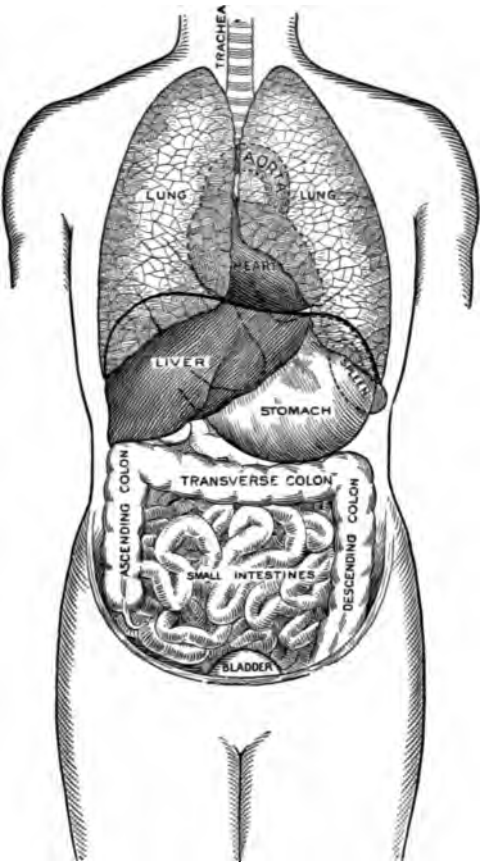


FIG. 30.—Position of the thoracic and abdominal organs (front view).

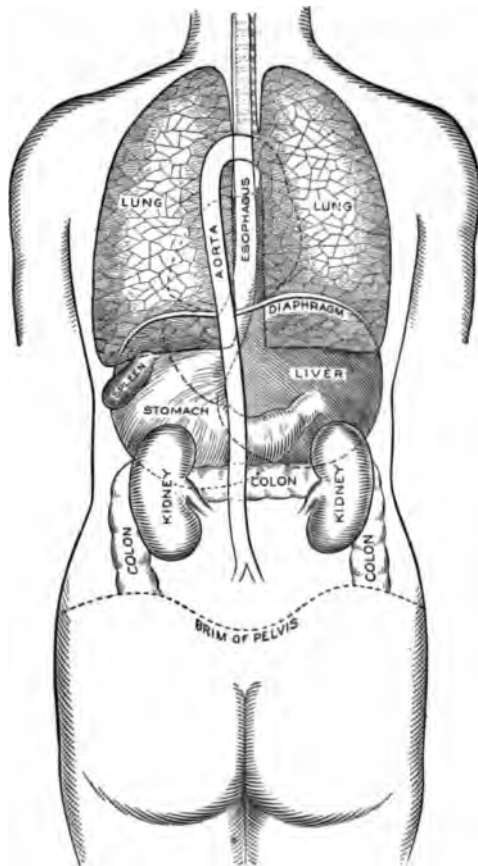


FIG. 31.—Position of the thoracic and abdominal organs (rear view).

being on a higher plane than the lower edges of the lungs. Consequently a knife thrust into the chest on the right side between the sixth and seventh ribs, and penetrating sufficiently deep, would not only injure the lung, but would also penetrate the diaphragm and liver.

The **Stomach** lies upon the left side of the abdomen beneath the diaphragm and is partly covered by the ribs of that side.

**The Spleen.**—Just beneath the stomach and lying posteriorly well to the left under the ribs is the spleen. Its position corresponds to about the ninth, tenth, and eleventh ribs.

**The Kidneys.**—On either side of the spinal column, and resting upon the posterior abdominal wall and part of the diaphragm, are the two kidneys, the right lying on a somewhat lower plane than the left. The upper end of each kidney corresponds to about the eleventh rib behind. The lower extremities extend to within about two inches of the crests of the ilia.

The **Pancreas** lies behind the stomach and extends across the abdomen on its posterior wall opposite the second lumbar vertebra.

The **Small Intestine**, divided into the duodenum, jejunum, and ileum, occupies the greater portion of the cavity of the abdomen.

The **Large Intestine** consists of the cecum, ascending colon, transverse colon, descending colon, and rectum.

The *cecum* and *appendix* lie low down in the abdomen upon the right side just above the pelvis; the *ascending colon* passes upward from the cecum on the right side of the abdomen to the under surface of the liver; the *transverse colon* crosses the abdomen beneath the liver and stomach; and the *descending colon* descends upon the left side of the abdomen to the pelvis.

Injury to the intestines from a stab or bullet wound, aside from the dangers of infection and peritonitis from leakage of the intestinal contents, is a serious accident because the

intestines, being coiled and closely packed together, are usually damaged in more than one place.

In the abdominal cavity, lying upon or in the neighborhood of the spinal column, besides these organs are found certain other structures,—the *aorta*, the main artery of the body; the *inferior vena cava*, the large vein of the trunk; some lymph-vessels; and some nerves.

**The Contents of the Pelvis.**—The **Rectum**, or terminal part of the large intestine, occupies the posterior part of the pelvis.

The **Bladder** occupies the anterior portion of the pelvis.

**The Uterus.**—In the female, between the bladder and rectum, lie the uterus and its appendages.

## CHAPTER IV.

### THE VASCULAR AND LYMPHATIC SYSTEMS.

#### THE VASCULAR SYSTEM.

The vascular system consists of a central chamber and a series of closed tubes in which the fluid blood circulates, carrying nourishing material to the tissues and conveying away substances which are no longer useful. The central chamber of this great system is the heart, while the series of tubes are the arteries, capillaries, and veins. The arteries carry blood from the heart to the tissues. Here, by means of the capillaries, the blood gives up its nourishment and in return becomes laden with waste material. The veins then convey this blood back to the heart and lungs.

#### THE HEART.

The heart is a hollow, muscular organ which propels the blood through the body. It may be said to be the force-pump of the whole vascular system. It is about 5 inches long and somewhat conical in shape, lying obliquely in the chest cavity between the lungs with its base upward and to the right, and with its apex down and to the left. The impulse of the apex against the chest wall, commonly known as the heart-beat, which occurs with each contraction of that organ, can be felt between the fifth and sixth ribs at a point about  $3\frac{1}{2}$  inches to the left of the median line.

Inclosing the heart is a double membranous sac, the *pericardium*. One layer of the pericardium is closely adherent to the surface of the heart muscle, forming a thin, glistening covering, while the other layer loosely surrounds the heart, but is not adherent to its surface. Between the two layers there is a small quantity of fluid. The pericardium by means of its



smooth surfaces prevents friction when the heart moves during a contraction.

**The Cavities of the Heart.**—The heart presents a right and a left side, further subdivided into four cavities,—the right and left auricles, and the right and left ventricles.

The **Right Auricle**, composing the upper part of the right side of the heart, occupies the upper and anterior portion of the base. It is a small cavity capable of holding about two ounces

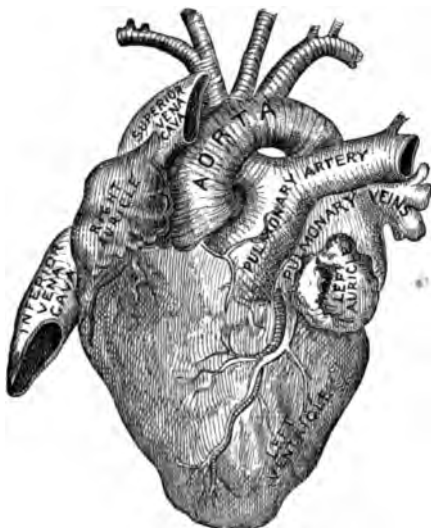


FIG. 32.—The heart (Stoney).

of blood. It opens into the right ventricle through the right auriculo-ventricular opening, and upon its posterior wall there are openings for the superior and inferior venæ cavæ.

The **Right Ventricle**, composing the lower portion of the right side of the heart, occupies the greater part of its right border and anterior surface. It is larger than the right auricle, and its walls are thicker. It resembles an inverted triangle, in the base of which are two openings, the auriculo-ventricular and the pulmonary. The auriculo-ventricular orifice is guarded by a valve consisting of three triangular segments, the

*tricuspid valve*, while the pulmonary opening is guarded by a valve composed of three semilunar folds of tissue, the *semilunar valve*. The inner surface of the ventricle is very irregular, due to a number of muscular projections, the *columnæ carneæ*. Some of these are called the *papillary muscles*, and from these numerous small cords, the *chordæ tendinæ* extend to each segment of the tricuspid valve.

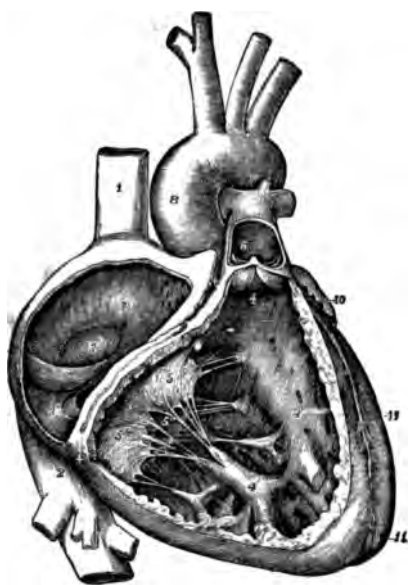


FIG. 33.—Right auricle and ventricle opened: 1, Superior vena cava; 2, inferior vena cava; 3, right auricle; 4, cavity of right ventricle; 4', papillary muscles; 5', 5'', 5''', tricuspid valve; 6, pulmonary artery and semilunar valve; 7, 8, aorta; 10, left auricle; 11, left ventricle (Leidy).

The **Left Auricle**, composing the upper portion of the left side of the heart, occupies the posterior part of the base. It is smaller in size than the right auricle, and its walls are thicker. It communicates with the left ventricle by the left auriculo-ventricular opening, and also has four openings for the pulmonary veins.

The **Left Ventricle**, composing the lower portion of the left side of the heart, occupies its left border. It has the same

general structure as the right ventricle, only it is longer and more conical, and its walls are three times as thick. At its base are two openings, the left auriculo-ventricular orifice and the aortic. The auriculo-ventricular opening is guarded by



FIG. 34.—Left auricle and ventricle, opened and part of their walls removed to show their cavities: 1, Right pulmonary vein cut short; 1', cavity of left auricle; 3, 3', thick wall of left ventricle; 4, portion of the same with papillary muscle attached; 5, the other papillary muscles; 6, 6', the segments of the mitral valve; 7, in aorta is placed over the semilunar valves; 8, pulmonary artery; 10, aorta and its branches (Allen Thomson).

a valve consisting of two segments, the *mitral valve*. As in the tricuspid valve, the chordæ tendinæ attach the free edges of these segments to the papillary muscles. The aortic opening is protected by a *semilunar valve*, similar to the one on the right side guarding the pulmonary artery.

#### The Working of the Heart.

—If we simply remember that the heart consists of four cavities—two auricles into which open the great veins of the body, and two ventricles into which the auricles empty and from which spring the two main arteries of the body—we can more readily understand what occurs when the heart is in action, or, in other words, in a state of contraction, for it is solely by the contractions of the heart that the blood is propelled along and kept moving through the vessels of the body. This action is a

rhythmical one,—that is, there is a simultaneous contraction of both auricles, followed by a simultaneous contraction of both ventricles, and then a period of rest, during which the heart dilates and again becomes filled with blood, followed by another contraction and a period of rest. The period during

which the heart is contracting is known as the *systole*, or beat of the heart, while the period of rest is the *diastole*. With each systole the apex of the heart strikes the chest wall, producing the *apex-beat*.

When the auricles contract their cavities become smaller in all directions, and a compression is exerted upon the volume of contained blood, so that it naturally escapes in the direction of least resistance, or toward the openings in the auricles,—those for the large veins and the auriculo-ventricular openings. It is prevented from flowing back into the great veins which brought it to the auricles by the oncoming current of blood, and thus is forced toward the ventricles, in which direction there is but little resistance, as they are at this time empty and easily distended. As the ventricles become filled, the blood distends all portions of these cavities and, working back behind the auriculo-ventricular valves, floats them out, causing them to partially close. Finally, the ventricles become so filled that the auricles are unable to further overcome the resistance offered, and their contractions cease. As soon as this occurs the walls of the auricles relax, and the cavities commence to refill with a fresh supply of blood which flows in from the great veins.

Immediately with the ending of the auricular contractions the ventricles commence to contract, thereby forcing the blood in the direction of least resistance, or back toward the empty auricles. The pressure exerted by the blood upon the auriculo-ventricular valves, however, pushes them closer together, so that, unless they are weakened or deformed by disease, they become tightly closed and completely shut the openings they guard. The valves are prevented from being driven back into the auricles by the action of the chordæ tendinæ, which tighten and hold their edges in place. The blood contained in the ventricles is thus compelled to find some other avenue of escape and passes into the large arteries, but to do this it has to overcome considerable resistance, chiefly that offered by the mass of blood in the arteries held back by the semilunar valves.

Hence, when we see the amount of work the ventricles are compelled to do, it is easy to understand why they have walls so much thicker than those of the auricles.

With the passage of blood into the large arteries, a slight shock is transmitted through the whole column of blood therein contained, and the vessel walls, being elastic, dilate and become distended by this increased quantity of fluid. This dilatation occurs with each contraction of the ventricles and may be felt in any of the arteries as the *pulse*. As soon as the ventricles cease contracting and forcing blood into the arteries, these dilated vessels, again through their elasticity, return to their normal size. In doing this they squeeze their contents and tend to force the blood along the vessel in both directions; but backward toward the heart any return of blood is prevented by the closure of the semilunar valves, so the column of blood is forced onward into the smaller arterial branches and capillaries.

To summarize the action of the heart briefly, we may say the auricles contract and pour their contents into the ventricles, refilling again as soon as empty; the ventricles then contract, pour their contents into the arterial system, and become again refilled from the auricles. This whole process is called the *cardiac cycle*, and occurs in healthy adult persons on an average of 72 times a minute; in infants and young children it is more rapid, varying between 150 and 100 times a minute.

**The Heart Sounds.**—If one applies the ear to the chest and listens to the beating heart, two sounds will be heard. First, there is a rather prolonged and muffled sound, immediately followed by a short, sharp one, then a period of rest; then the two sounds are again heard, then a period of rest, and so on. The first sound is supposed to be produced by the closure of the tricuspid and mitral valves and the contractions of the ventricles, while it is certain that the second sound is caused by vibrations produced when the semilunar valves of the aorta and pulmonary artery close.

In certain diseases of the heart the character of the sounds is

markedly changed, and the physician is thus able to gain important information as to the conditions which are present.

### THE ARTERIES.

The arteries are cylindrical elastic tubes which convey the blood from the heart to every portion of the body. The arterial system, beginning at the heart, consists of two large vessels, the aorta, and the pulmonary artery. By continually dividing and subdividing innumerable branches are formed which permeate all portions of the body and, getting smaller and smaller, finally terminate as minute vessels called *capillaries*. Thus all the

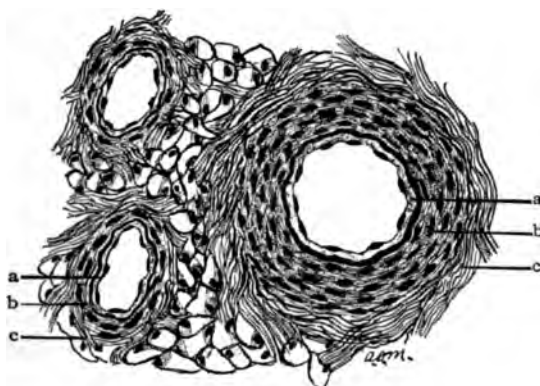


FIG. 35.—Cross-section of an artery and two veins showing the relative thickness of the walls. a, Inner; b, middle; c, outer coat.

arteries of the body, except the pulmonary artery supplying the lungs, are indirectly branches of one large vessel, the aorta.

The only valves found in arteries are those already described guarding the openings of the aorta and pulmonary artery in the heart.

**Structure of an Artery.**—An artery is composed of three coats,—an inner, middle, and outer tunic.

The *inner coat* is composed of a single layer of epithelial cells lying on a membrane of elastic tissue. It forms a smooth lining for the vessel, and thus lessens the friction between the circulating blood and the vessel wall.

The *middle coat* is composed of involuntary muscular tissue and yellow elastic tissue. The elastic tissue gives elasticity to the vessel wall and enables it to return to its normal size after it has been distended. The elastic tissue varies greatly in amount, in the large arteries forming the greater part of the middle coat, while in the smaller vessels it is absent, the muscular coat alone being present.

The *outer coat* is composed of fibrous tissue which contributes to the strength of the vessel.

Surrounding the artery is a sheath of connective tissue in which lie the nerves and blood-vessels which supply the artery itself. The thickness of the arterial coats causes the vessel to remain distended when empty, thereby differing from the veins, which under like conditions collapse.

**The Course and Distribution of the Arteries.**—The **Aorta**, the largest blood-vessel of the body, begins at the left ventricle and passes upward in the form of an arch upon the right side of the spine, then crosses it and passes down upon the left side, gradually approaching the median line of the body. It then passes through the diaphragm into the abdomen, and, after giving off branches to the thoracic and abdominal viscera, terminates opposite the fourth lumbar vertebra by dividing into the two common iliac branches.

The **Innominate Artery**, 1 1/2 inches in length, arises from the aorta, passes up in front and to the right of the trachea and divides into the right common carotid and the right subclavian arteries.

**The Common Carotid Artery.**—The right arises from the innominate, the left from the arch of the aorta. Both vessels pass up the side of the neck and, opposite the upper border of the thyroid cartilage (a part of the larynx), divide into an internal and external branch.

The **Internal Carotid** passes up the side of the neck, lying deeply imbedded in the muscles, and enters the skull through the temporal bone to supply the brain and eyes.

The **External Carotid** passes up the side of the neck more

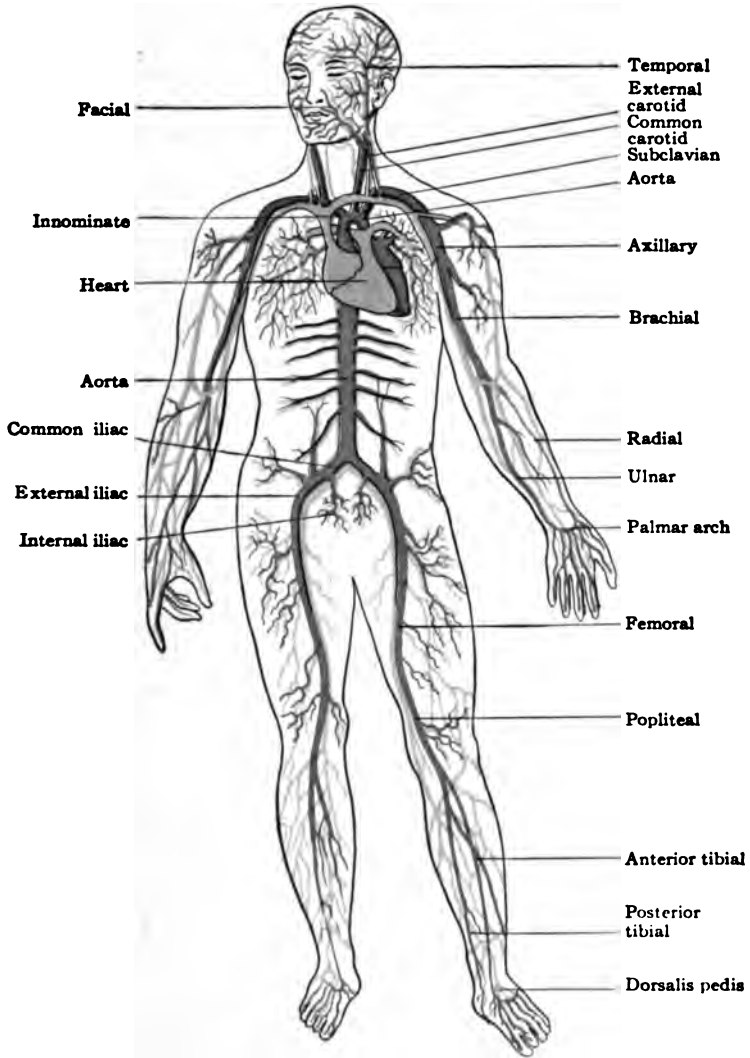


FIG. 36.—The principal arteries and veins of the body.



superficially than the internal to supply the larynx, pharynx, tongue, face, nose, ears, and scalp. In its course it gives off a number of branches, the most important of which, considered from the point of liability to injury, are the facial, the temporal, and the occipital. The *facial* branch crosses the lower jaw in a groove about one inch in front of the angle of the jaw. The *temporal* branch passes up just in front of the ear to supply the sides of the scalp. The *occipital* branch passes upward upon the back of the head to supply the back of the scalp.

The **Subclavian Artery**, arising from the innominate upon the right and from the aorta upon the left, passes up over the first rib but under the clavicle in the form of an arch.

The **Axillary Artery** is a continuation of the subclavian. It extends from the lower border of the first rib to the lower border of the armpit.

The **Brachial Artery**, a continuation of the axillary, passes down the inner side of the arm along the inner border of the biceps muscle, gradually approaching the anterior portion of the arm. An inch below the elbow it divides into the ulnar and radial arteries.

The **Ulnar Artery** passes along the inner side of the forearm to the wrist, and unites with a branch of the radial to form the superficial palmar arch.

The **Radial Artery** passes down the outer side of the forearm to the wrist where it winds around the thumb and, passing through the muscles between the thumb and first finger, appears upon the palm to form with a branch from the ulnar the deep palmar arch.

The **Common Iliac Arteries**, termed the right and the left, are the terminal branches of the abdominal aorta. They are about two inches long and extend from the fourth lumbar vertebra to the upper border of the sacrum, where they divide into internal and external branches.

The **Internal Iliac** enters the pelvis, the contents of which it supplies.

The **External Iliac** passes down along the brim of the pelvis to the thigh, where it becomes the femoral.

The **Femoral Artery** passes down the front of the thigh, its course being represented by the upper two-thirds of a line extending from the center of the groin to the internal condyle of the femur, and then, piercing the thigh muscles, it gradually works its way to the back of the thigh.

The **Popliteal Artery** is a continuation of the femoral. It passes obliquely downward and outward behind the knee-joint and, below the knee, divides into anterior and posterior tibial branches.

The **Anterior Tibial** pierces the muscles of the leg and appears upon its anterior surface. It then passes down the outer side of the leg, lying deeply in the muscles above and becoming superficial as it nears the ankle-joint. At the bend of the ankle it becomes the *dorsalis pedis artery*, and as such supplies the anterior portion of the foot.

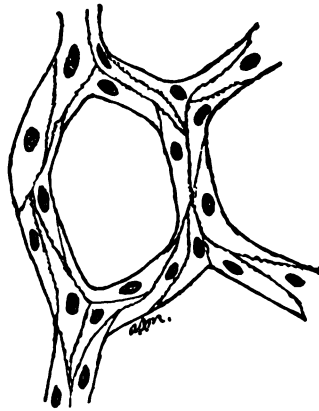


FIG. 37.—Diagram of capillaries.

The **Posterior Tibial** extends down the back and inner side of the leg to the ankle, here lying superficially between the heel and internal malleolus. It finally enters the sole of the foot and divides into internal and external plantar branches.

### THE CAPILLARIES.

Capillaries (meaning hair-like) are minute vessels, lying deep in the tissues, interposed between the arteries and veins. They are but a small fraction of an inch in length, and their walls, composed of but a single layer of epithelial cells, are so thin that the contents of the vessel can readily pass out between the cells into the tissues in which they lie. In this way an inter-

change of nutrient and waste material is effected between the blood and tissues.

### THE VEINS.

The veins begin where the capillaries end, and are tubes which convey the blood, previously carried by the arteries to the capillaries, back to the heart. They are more numerous than the arteries, usually two veins accompanying each artery. The smaller veins from different parts of the body continually unite to form larger veins which eventually terminate either in the

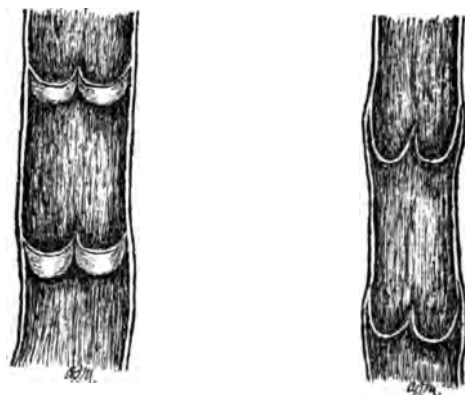


FIG. 38.—Diagram of the valves of veins.

superior or the inferior vena cava, and they, in turn, empty into the right auricle of the heart.

Veins differ from arteries in having upon their inner surface many small pouch-like projections, termed *valves*. They prevent a backward flow of blood toward the capillaries during muscular contraction.

**The Structure of a Vein.**—Like an artery, a vein has three coats,—inner, middle, and outer.

The *inner* and *outer coats* have the same structure as is found in the corresponding coats of an artery.

The *middle coat* is much thinner than that of an artery and contains but little elastic tissue.

Veins are usually inclosed in the same sheath of connective tissue as the artery they accompany and, like arteries, are supplied by nerves and blood-vessels.

#### THE BLOOD.

The blood is the fluid which circulates through the heart and blood-vessels. It is an alkaline, opaque fluid with a specific gravity of 1055, comprising  $1/13$  of the total body weight. In the arteries it has a bright red or scarlet color, due to the presence of oxygen, but when it reaches the veins it is dark red or blue, due to the presence of carbonic acid gas.

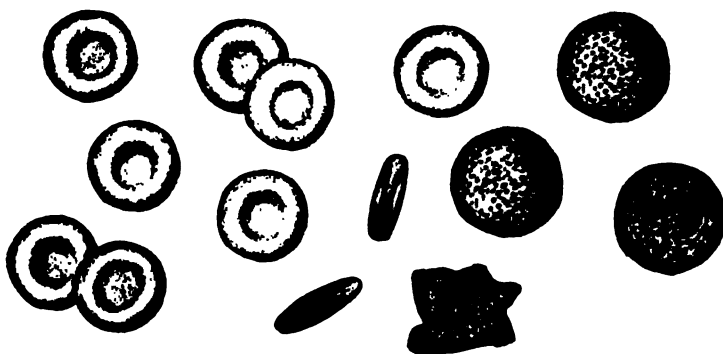


FIG. 39.—Blood cells. Red cells upon the left, white cells upon the right.

The blood is usually called the nutritive fluid of the body, because it supplies the tissues with certain nutritious material which has been separated and prepared by the digestive organs from the food taken into the stomach. It also has the function of carrying oxygen from the lungs to the tissues and of removing from the body through the lungs, kidneys, and skin, waste matter which is of no further use. Finally, it aids in maintaining and equalizing the bodily temperature.

It is composed of a liquid portion, called the *plasma*, in which are suspended innumerable small bodies, the *red* and the *white blood-corpuscles* and the *blood plates*.

The **red, or colored corpuscles**, also called *erythrocytes*, when examined under the microscope, are seen as bi-concave circular discs or cells. There are four to five million of these cells in one cubic millimeter, being many times more abundant than the white corpuscles. They are larger than some of the capillaries, but, being very flexible and elastic bodies, can adapt themselves to the size of the vessel through which they have to pass and then resume their normal size. The red coloring of these corpuscles is due to a pigment, called *hemoglobin*, which also has the power of easily combining with oxygen. The red cells may be said to be the oxygen-carrying bodies of the blood.

The **white, or colorless corpuscles**, also called *leukocytes*, are larger, fewer in number, and more irregular in outline than the red ones. In health they vary in number between five and seven thousand to each cubic millimeter. They possess the power of *ameboid movement*, which consists in a constant alteration in the shape of a cell as the result of contractions taking place in its substance. By means of this power, the cell is able to move from place to place. It accomplishes this by sending out a portion of its body in the form of a projection, then moving the rest of its body up to this, and sending out another process farther along in the same direction, and so on.

**Coagulation of the Blood.**—When blood is drawn from the body and allowed to stand a few moments, it becomes solidified and forms a jelly-like mass. This is known as *coagulation*, or clotting, and is due to the formation in the plasma of a fibrous-looking material, called *fibrin*. The blood-corpuscles become entangled in this fibrin, and thus is formed a semisolid mass consisting of the plasma, fibrin, and blood-corpuscles. If this clot is placed in a vessel and allowed to stand, a clear, yellowish fluid will be seen to appear, in which lies the original clot, but now somewhat changed in character, appearing shrunken and smaller than before. The fluid, thus formed, is called the *serum*, and its presence is due to the contraction of the fibrin

in the clot, which has shrunk and squeezed out the fluid portion.

Coagulation of the blood is nature's means for arresting a hemorrhage. It does not occur when the blood is circulating in healthy living vessels, but is hastened by exposure to air and contact with injured or diseased tissues, extreme heat or cold, and foreign bodies. The old-fashioned but very effective

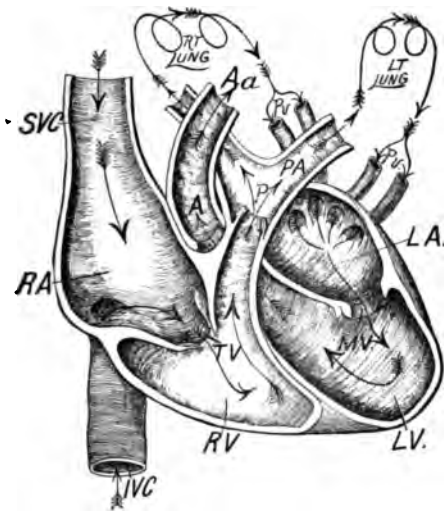


FIG. 40.—The circulation of the blood through the heart: *IVC*, Inferior vena cava; *SVC*, superior vena cava; *RA*, right auricle; *TV*, tricuspid valves; *RV*, right ventricle; *P*, pulmonary valves; *PA*, pulmonary artery; *Pv*, pulmonary veins; *LA*, left auricle; *MV*, mitral valves; *LV*, left ventricle; *A*, aortic valves; *Aa*, arch of aorta (Page).

means of stopping hemorrhage by applying cobwebs or lint scrapings to a bleeding wound causes a clot to form, because these substances act as foreign bodies.

**Circulation of the Blood.**—The fact that the blood is a fluid and that it moves continually in a definite direction through the body was discovered in 1616 by William Harvey, of England, the belief previous to that time being that the blood-vessels contained air. The course taken by the blood in its passage through the body is known as the circulation, and it may be described as follows:

The venous blood, collected by the superior and inferior venæ cavæ from the tissues of the body into the right auricle, as the result of the contraction of that cavity, passes through the right auriculo-ventricular opening into the right ventricle. By the contraction of the right ventricle it is forced into the pulmonary artery, which, first dividing into two main branches and then into innumerable small branches, carries it to the capillaries surrounding the air-vesicles in the lungs. Here the blood gives up its carbonic acid and receives a fresh supply of oxygen, and thus changes from venous to arterial blood. From the lungs the arterial blood is collected by the four pulmonary veins and is conveyed to the left auricle. By the contraction of this cavity it is forced through the left auriculo-ventricular opening into the left ventricle. The left ventricle then contracts and propels the blood into the aorta, thence into the smaller branches, and finally into the capillaries of the body, where it gives up the nourishment with which it is laden and receives waste matter from the tissues. The blood again becomes venous, and, collected by the many veins of the body, is eventually brought back to the right auricle, having made a complete circuit of the entire vascular system.

#### THE LYMPHATIC SYSTEM.

The lymphatic system is a very extensive network of small vessels distributed generally through the body, but profusely abundant beneath the skin and mucous membranes. Its circulating fluid is called the *lymph*. Lymphatics resemble veins in their structure and, likewise, have numerous valves. In addition there are present at various points along the course of the lymph-vessels small round bodies, the *lymph-nodes*, through which the lymph has to circulate.

It will be remembered that when the blood circulates through the thin-walled capillaries portions of it pass from the capillaries into the tissues, which it bathes, supplying them with nourishment. Some of this fluid, now called lymph, is first collected into lymph-spaces surrounding the tissues, and

then enters small lymphatic vessels which lead from these spaces. These small vessels continually unite into larger and larger vessels, and eventually form two large vessels, one of which, called the *thoracic duct*, passes up through the abdomen and thorax; the other—the *right lymphatic duct*—is found upon the right side low down in the neck; both of these vessels empty into the large veins at the root of the neck.

There is no special apparatus to make the lymph circulate, as the heart, which propels the blood through the vascular system. It, however, moves continually from the periphery to the center of the body, being apparently sucked along. The movement of this fluid in one direction occurs because the pressure where the lymphatics take origin in the tissues is greater than in the large lymph-vessels; likewise the muscular contractions of the body, such as occur in the hollow organs and in the limbs, press upon the lymph-vessels and squeeze their contents out toward the larger vessels. The valves of the lymphatics prevent the lymph from flowing back again when these contractions cease, and the empty vessels are again immediately filled by more lymph flowing in from the tissues.

The **Lymph** is a clear, colorless fluid, consisting of a liquid portion, and a solid portion containing white blood-cells, or lymphocytes. It differs from the blood in having no red cells and in being composed of a very small proportion of solid matter. During digestion the lymph found in the lymphatics of the intestinal canal becomes laden with fats and, as a result, changes somewhat in character, having now a milk-white appearance and being known as the *chyle*.

The **Lymph-nodes** are important in that they effect certain changes in the lymph, it being found that the lymph after passing through these nodes contains a greater number of lymphocytes; furthermore, the nodes act as filters or sieves for the whole lymphatic system, thus preventing infection from extending through these vessels to other parts of the body.



## CHAPTER V.

### THE RESPIRATORY SYSTEM.

Respiration, or breathing, is the process by which oxygen is taken into the body and carbonic acid gas expelled. Oxygen is necessary if the body is to perform its proper functions; in fact, it is absolutely essential for the maintenance of life. Taken into the lungs in the inspired air, it combines with the blood and is carried by this fluid to every portion of the body, uniting with the tissues of the body and the food as it is digested, and so permitting these materials to be oxidized or burned up. As oxidation proceeds, energy and heat are liberated, the energy being necessary in furnishing the body with power for work, and the heat to maintain the bodily warmth. As a further result of this oxidation or combustion a poisonous substance, *carbonic acid*, is formed in the tissues and blood, and some of this gas is expelled from the body with each expiration in the exhaled air.

Now, air deprived of oxygen or containing an excess of carbonic acid is equally dangerous. The prolonged breathing of such air will produce a condition of asphyxia, and finally death, just as certainly as would strangulation. Before this extreme condition occurs, however, such symptoms as headache, restlessness, and languor will be complained of by the person affected, symptoms which anyone who has been compelled to remain in an overcrowded and poorly ventilated room for any length of time may have felt. Continually breathing stale or stuffy air weakens a person and lowers the vitality, even in those who are more or less accustomed to it. To insure good health it is estimated that a person requires at least 1,000 cubic feet of air space, and the air breathed should be frequently replenished through proper ventilation.

The essential part of respiration, the interchange of carbonic acid gas and oxygen which is effected between the blood and

the air, takes place in the lungs. In the previous chapter we have seen how the blood makes its way to the lungs, but to understand the manner in which air is transmitted to these organs some knowledge of the arrangement and mechanism of the respiratory apparatus will be necessary.

The respiratory apparatus consists of the *nose*, *pharynx*, *trachea*, *bronchi*, and *lungs*.

#### THE NOSE.

The nose is not only an organ of respiration, but is also the organ of the sense of smell. Its interior is divided by a septum, consisting of bone and cartilage, into two irregular cavities, the

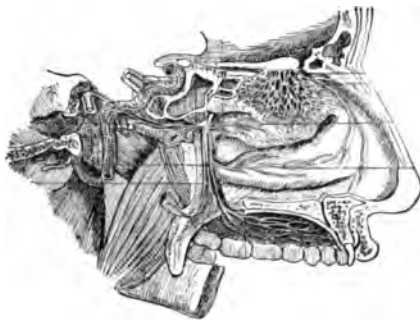


FIG. 41.—The interior of the nose, showing the nerve supply.

*nasal fossæ*. These fossæ are occupied chiefly by spongy, scroll-shaped projections of thin bone, known as the *turbinate bones*, and are lined by a thick mucous membrane which serves to warm and moisten the inhaled air. The interior of the nose in the upper part is also richly supplied by the *olfactory nerves*, which are endowed with a delicate sense of smell, and thus protect the lungs from the inhalation of harmful gases. Externally the nasal fossæ open as the two nostrils, and posteriorly they lead into the pharynx through the posterior nares.

#### THE PHARYNX.

The pharynx, which is also a part of the alimentary tract, is the conical musculo-membranous sac forming the throat, or

back part of the mouth. It is 4 1/2 inches long, and is lined with a mucous membrane which is continuous with that of the nose and mouth. Extending from the lower portion of the pharynx are the openings for the esophagus and the larynx, the former lying behind and the latter in front.

### THE LARYNX.

The larynx, while forming a part of the respiratory apparatus, has a more specialized function of being the principal organ

of voice. It is a sort of triangular box, broad above, and narrowed below where it leads into the trachea, composed of a number of cartilages and lined by mucous membrane. Its projection can readily be felt through the skin as "Adam's apple."

Internally the larynx presents a constriction at about its middle, through which there is a slit-like opening, the *glottis*, the edges of which are formed by sharp fibrous bands, the *vocal cords*. Above and parallel to the vocal cords are two second folds of mucous membrane inclosing ligamentous tissue, commonly called the false vocal cords. The

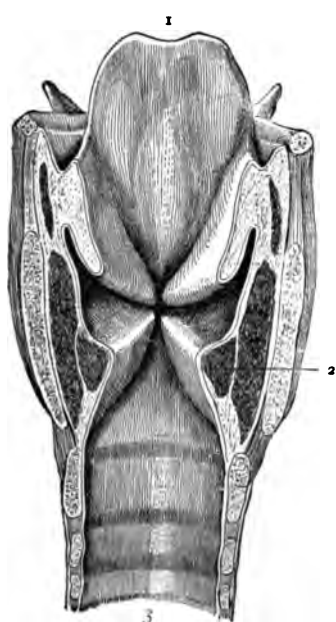


FIG 42.—Interior of the larynx. 1, Epiglottis; 2, vocal cord; 3, cavity of the trachea (after Testut).

glottis is opened and closed by the action of certain muscles. When it becomes narrowed, the vocal cords are tightened and vibrations are caused during expiration which produce the voice, but ordinarily the glottis lies open, and no sound is produced by the inflow and outflow of the air. The glottis is covered by a piece of cartilage, the *epiglottis*, which acts as a

lid and prevents particles of food and foreign bodies entering the larynx.

#### THE TRACHEA.

The trachea, or windpipe, is a cylindrical tube  $4\frac{1}{2}$  inches long extending from the larynx down the front of the neck into

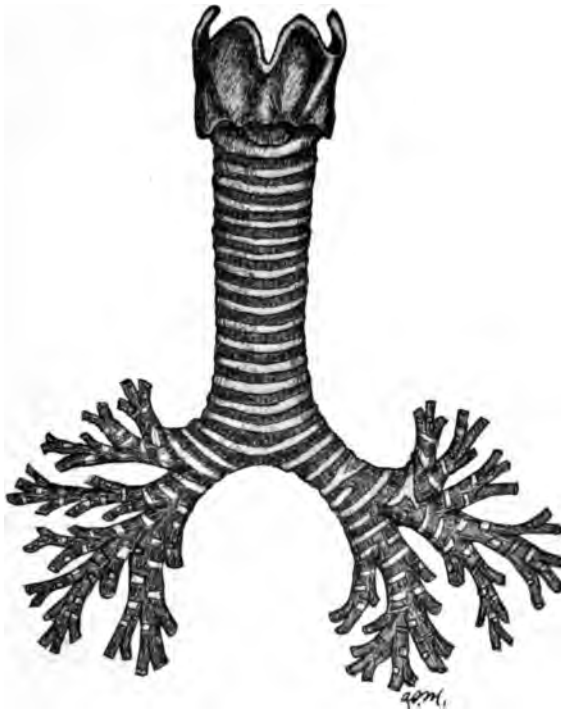


FIG. 43.—Larynx, trachea, and bronchi.

the thorax, where it divides into the two bronchi. It is prevented from collapsing by the presence of from fifteen to twenty incomplete rings of cartilage, placed one above the other and united by a thin membrane. The posterior wall, where these rings fail to meet, is formed by fibrous and muscular tissue, and the whole tube is lined by mucous membrane.

## THE BRONCHI.

The bronchi are the two branches resulting from the bifurcation of the trachea, and have the same general structure as the trachea. They enter the lungs and divide into a great



FIG. 44.—Diagrammatic representation of the termination of a bronchial tube in a group of infundibula; *B*, bronchial tube; *LB*, bronchiole; *A*, atrium; *I*, infundibulum; *C*, alveoli (Nancrede)

number of small branches, the *bronchial tubes* or *bronchioles*, which in turn divide and subdivide and finally terminate in an innumerable number of small dilated cavities or pouches, the *air vesicles*, or *alveoli*.

The bronchi and bronchial tubes are lined with a form of mucous membrane, known as *ciliated*, which is different from that found in the rest of the respiratory tract. It has numerous hair-like projections on its surface, which wave and produce a current in a direction away from the air cells, and so tend to prevent the entrance of dust and foreign matter into the lungs.

## THE LUNGS.

The lungs in the adult are two slate-colored, cone-shaped organs composed of a soft, spongy, and very elastic tissue. They occupy the greater part of the chest cavity, lying on either side of the spinal column and resting on the diaphragm, but separated from each other by the heart. The left lung is divided by a deep fissure into an upper and lower lobe, while the right lung is further subdivided by a second fissure into an upper, middle, and lower lobe. The lungs are united on the inner surfaces to the heart and trachea by the *roots*, which consist of the bronchi, pulmonary arteries and veins, lymphatics, small vessels, and nerves. Each lung is inclosed in a double membranous sac, similar to the pericardium, called the *pleura*, one layer of which is closely adherent to the lung itself, while

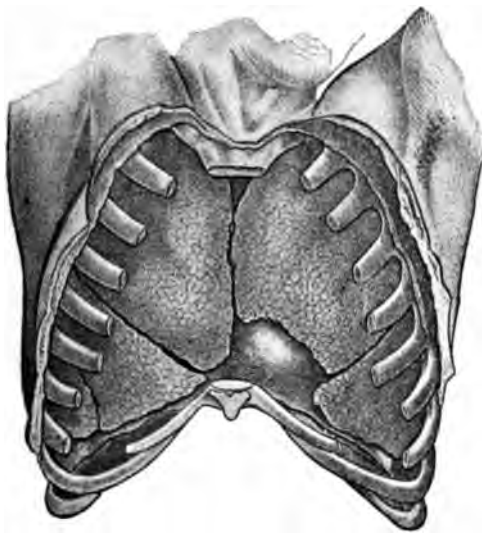


FIG. 45.—The lungs (MacLise).

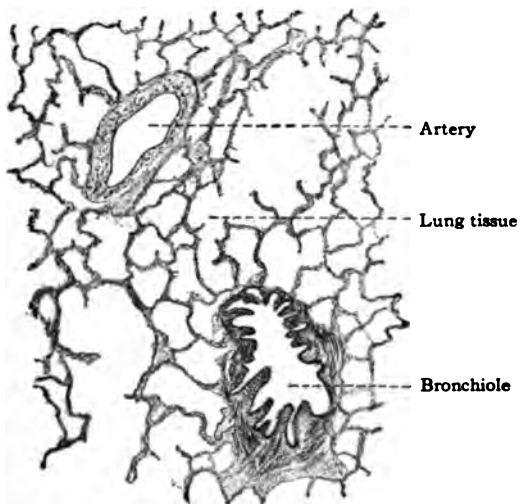


FIG. 46.—Section of cat's lung.  $\times 52$  (Böhm and Davidoff).

the other layer lines the chest cavity. Between the two layers is a small quantity of fluid which serves to moisten their surfaces and prevent friction when the lung moves during respiration.

The lung substance is composed chiefly of the air vesicles, or cells. These cells are  $1/70$  to  $1/200$  of an inch in diameter, with walls consisting of a very thin layer of epithelial cells, surrounding which are the wide, thin-walled pulmonary capillaries. By this arrangement only a very delicate membrane is interposed between the air on one side and the blood on the other, so that an exchange of gases between the two readily occurs. The venous blood is brought to the capillaries, where it expels into the air cells the carbonic acid and waste matter with which it is laden and receives in return a new supply of oxygen, which is taken up by the red blood cells. Thus a change from venous to arterial blood is effected.

#### RESPIRATION.

The respiratory act is involuntary, and occurs in a healthy individual ordinarily from 16 to 20 times a minute. It is composed of two distinct periods: *inspiration*, and *expiration*.

**Inspiration** is the process by which the lungs become inflated with air through the expansion of the thorax. This enlargement is accomplished mainly by the contraction of the diaphragm and intercostal muscles. The diaphragm at rest is somewhat convex and projects like a dome into the thorax. When it contracts, it becomes flattened, and thus the capacity of the thorax in the vertical diameter is increased. When the intercostal muscles contract the ribs are elevated, and the capacity of the thorax in its antero-posterior diameter is increased. As the chest cavity enlarges, the lungs, being elastic, readily follow the chest wall and become distended, at the same time drawing in through the trachea sufficient air to fill them. In this way, with each inspiration, the lungs are furnished with a fresh supply of air from which the blood can abstract the oxygen.

**Expiration** is the process of expulsion of air from the lungs, and it is effected by the return of the thorax to its original size. Quiet expiration is a passive act,—that is, the diaphragm and intercostal muscles simply relax, and the extra air taken in during inspiration is driven out; in forced expiration, however, the abdominal muscles and certain of the intercostal muscles are brought into play and the chest is thus compressed.

The fullest capacity of the lungs is 330 cubic inches of air, but during ordinary quiet respiration the inflow and outflow of air, known as *tidal air*, amounts to only 30 cubic inches. The lungs, however, never become entirely empty or collapse, and there remains about 75 to 100 cubic inches of air that cannot be gotten rid of, called *residual air*. In addition, there is in the chest after ordinary expiration about the same quantity of air, the *reserve* or *supplemental air*, which can only be expelled by forced expiration. Thus, after an ordinary inspiration the lungs contain about 230 cubic inches of air. By taking a very deep and long inspiration about 100 cubic inches more air can be added, and this is called the *complemental air*.

The expired air differs from that inspired in that it is always of the temperature of the body, no matter how cold the outside atmosphere may be, so that with each expiration a certain amount of heat is lost. In this way the body is continually being cooled off. Again, the expired air is always saturated with moisture, no matter how dry the inspired air may have been. Expired air also contains less oxygen and more carbonic acid than that inspired, and is, in addition, laden with other waste material, the result of decomposition occurring in the body.

**Modified Respiration.**—There are besides the act of respiration certain other acts connected either with inspiration or expiration which may be called modified respirations. Some of these are involuntary like the act of respiration itself, while others are distinctly voluntary and under the control of the will. The modified acts of respiration include coughing, sneezing, crying, laughing, sobbing, sighing, yawning, snoring, and hiccough.



**Coughing** consists mainly in a forcible expiration. An inspiration is first taken, followed immediately by a sudden, sharp expiration by which the glottis is forcibly thrown open, the air, driven out through the mouth, producing a characteristic sound. In this way foreign bodies may be expelled from the respiratory tract.

**Sneezing** is a reflex act caused by irritation of the nerves of the nose. As in coughing, it consists of an inspiration followed by a sudden expiration. The air, however, is driven out through the nose, with the result that any foreign substances which may be there are forcibly expelled.

**Crying** and **laughing** both consist of an inspiration followed by several repeated expirations. They differ from coughing in that the vocal cords vibrate with each expiration, producing various sounds. Crying differs from laughing in the expression of the face, and the former is accompanied by a profuse flow of tears.

**Sobbing** consists in a number of spasmodic inspirations, followed by a prolonged expiration.

**Sighing** is simply a long, deep inspiration followed by a long expiration.

**Yawning**.—The mouth is stretched wide open, and a long inspiration is taken, followed by a short expiration with which is usually produced a peculiar sound.

**Snoring** is caused by air respired through the open mouth, producing vibrations in the relaxed soft palate.

**Hiccough** is due to spasmodic contractions of the diaphragm resulting in a sudden inspiration, which is abruptly shut off by the closure of the glottis.

## CHAPTER VI.

### THE DIGESTIVE SYSTEM.

The digestive system, or alimentary apparatus, may be considered as consisting primarily of a long tube, composed of the mouth, pharynx, esophagus, stomach, and intestines, with the salivary glands, liver, and pancreas as accessory organs. This

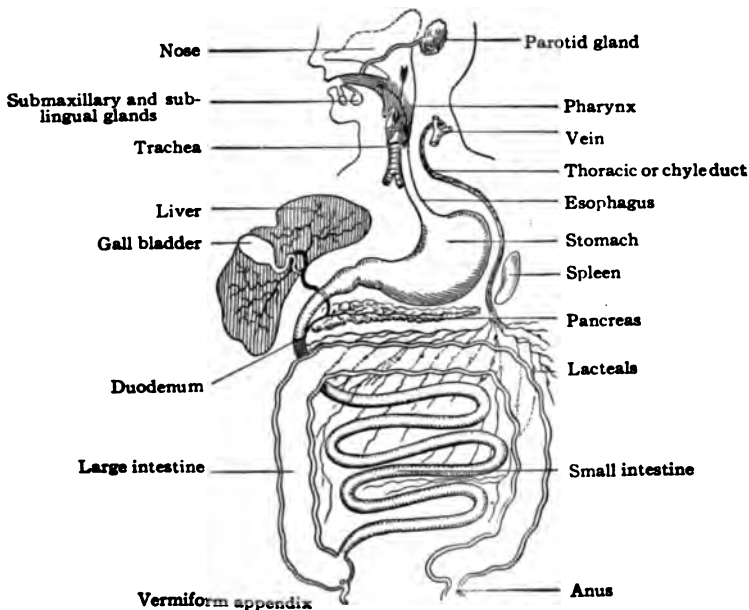


FIG. 47.—General scheme of the digestive tract, with the chief glands opening into it (Raymond).

tube, or *alimentary canal* as it is called, is about thirty feet long, of varying diameters, and extends from the mouth to the fundament, or anus. Its purpose or function is, first, to separate the nutritious material from the food and expel the residue from the body; second, to convert the nutritious matter into such a

form that it can be easily absorbed into the blood and be utilized by the tissues. To understand how this is accomplished, some knowledge of the separate parts forming this complicated apparatus will be necessary.

#### THE MOUTH.

The mouth for convenience may be described as an oval cavity\* forming the commencement of the alimentary canal, bounded in front by the lips, laterally by the cheeks, behind by the soft palate and opening of the pharynx, above by the hard palate, and below by the floor of the mouth and tongue. Suspended from the posterior border of the hard palate, and narrowing the opening between the mouth and pharynx, is a movable fold of mucous membrane, the *soft palate*; hanging down from its center is a small projection, the *uvula*; while extending from the uvula downward and forward on either side are two folds of tissue known as the pillars of the soft palate. Between these two pillars are located the *tonsils*. Separated from the cavity of the mouth by the soft palate is the pharynx or throat, which has already been described (page 75).

The **tongue** lies in the floor of the mouth, and is composed of muscular fibers in which are imbedded nerves and blood-vessels. Its base is attached to the adjacent structures by numerous muscles, while its tip and sides are free. Extending from the under surface of the tongue to the floor of the mouth is a fold of mucous membrane called the *frenum*. The upper surface of the tongue is covered by a mucous membrane which is raised into numerous projections, the *papillæ*, and gives to the tongue its rough appearance, while beneath the mucous membrane lie the so-called taste-buds.

**The Teeth.**—Extending around inside the lips and cheeks in the form of an arch are the two rows of teeth, thirty-two in all, consisting of two incisors, one canine, two bicuspid, and three molars in each half of each jaw. The teeth have as a special

\*Strictly speaking the mouth is only a cavity when the lips and jaws are open; at other times the whole cavity is filled by the tongue.

function the grinding up of food, and are necessarily made up of a very strong, dense substance called *dentin*, which is covered with *enamel*, the hardest substance in the body. The interior of the tooth is known as the *pulp cavity* (Fig. 49), and contains blood-vessels and nerves. Each tooth consists of three portions: the fang, or root, which lies imbedded in the jaw; the crown, or that portion projecting beyond the gums; and

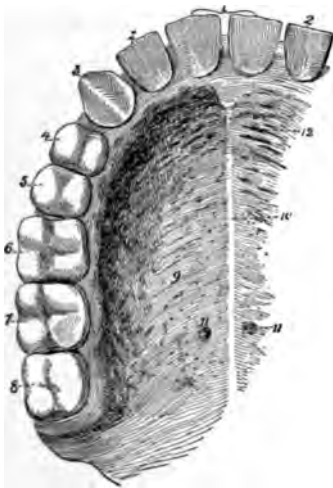


FIG. 48.—The teeth: 1, Median incisors; 2, lateral incisors; 3, canine; 4, first bicuspid; 5, second bicuspid; 6, first molar; 7, second molar; 8, wisdom tooth (after Testut).

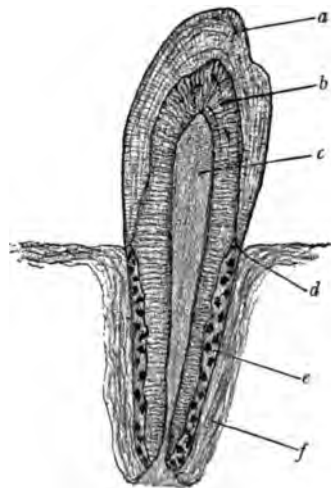


FIG. 49.—Tooth: *a*, Enamel; *b*, dentin; *c*, pulp cavity; *d*, junction of enamel and cementum; *e*, cementum; *f*, alveolar periosteum (Leroy).

the neck, or that portion covered by the gums lying between the root and the crown. Particles of food, if allowed to collect between the teeth, undergo fermentation and produce an acid which eats away the enamel, so that, unless the teeth are kept properly cleaned, decay is very apt to follow.

The interior of the mouth is lined with a mucous membrane which contains numerous glands, the *buccal glands*, and has openings upon its surface for the ducts of the salivary glands. These consist of three pairs of large glands: the parotid, submaxillary, and sublingual.

**The Salivary Glands.**—The *parotid gland*, the largest of the three salivary glands, lies upon the side of the face just below and in front of the ear. It has a duct, *Stenson's duct*, about 2 inches long which runs along between the muscles of the face

and opens as a slit upon the inner surface of the cheek near the second molar tooth of the upper jaw.



FIG. 50.—The salivary glands: *a*, Sublingual gland; *b*, submaxillary gland, with its duct opening on the floor of the mouth beneath the tongue at *d*; *c*, parotid gland and its duct, which opens on the inner side of the cheek at *e* (after Yeo).

The *submaxillary gland* is situated upon the side of the floor of the mouth below the lower jaw. Its duct, *Wharton's duct*, is about 2 inches long and opens just in front of the root of the tongue beside the frenum.

The *sublingual gland* is the smallest of the three pairs of glands, and lies just beneath the mucous membrane at the front part of the floor of the mouth.

It opens into the mouth below the tongue by from 8 to 20 small ducts.

The secretion from these glands, mixed with that from the many small glands in the mucous membrane of the mouth, forms the saliva, or "spit." It is an alkaline fluid, containing as its active principle a substance called *ptyalin*, which has the property of changing insoluble starch into a very soluble sugar, *maltose*.

### THE ESOPHAGUS.

Extending downward from the lower part of the pharynx in front of the spinal column and terminating in the stomach is the *esophagus*, or gullet. It is a canal about 10 inches long, composed of a fibrous, a muscular, and a submucous coat and an inner lining of mucous membrane. It serves to convey the food from the mouth to the stomach.

## THE STOMACH.

The stomach is an inverted, pear-shaped, bag-like dilatation of that part of the alimentary canal lying between the esophagus and intestines. The greater portion of it lies upon the left side of the abdomen below the diaphragm and beneath the anterior abdominal wall. The larger dilated end, lying to the left, is called the *cardiac extremity*, while the smaller end, lying to the right, is called the *pyloric extremity*, and the portion between the two is known as the *body*. Where the stomach opens into the small intestine there is a muscular ring, the *pylorus*, which acts

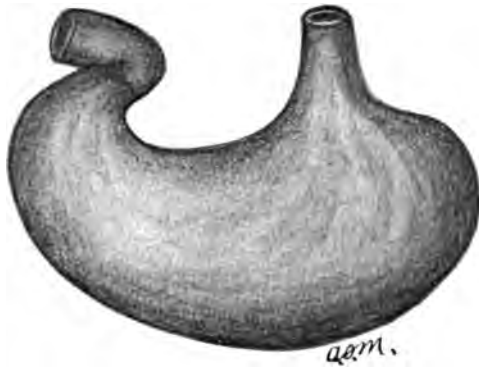


FIG. 51.—The stomach.

as a valve. The stomach being a very distensible organ, its capacity is subject to wide variations. Its average capacity, however, may be said to be about  $2\frac{1}{2}$  pints. When moderately distended, its greatest diameter measures 10 to 12 inches; when empty, it lies in a collapsed condition.

**Structure of the Stomach.**—It is composed of 4 coats: serous, muscular, submucous, and mucous.

The *serous*, or *peritoneal coat*, is the thin glistening membrane covering the exterior of the organ.

The *muscular coat* is composed of 3 layers of involuntary muscular fibers arranged in different directions: an outer longitudinal, a middle circular, and an inner oblique. By the

contraction of these muscular fibers the contents of the stomach are mixed and churned up.

The *submucous coat* consists of connective tissue and contains blood-vessels, lymphatics, and nerves.

The *mucous coat* is a thick, pink mucous membrane forming the inner lining of the stomach. When the stomach is empty it is thrown into numerous folds, which disappear when the organ becomes distended.

The surface of the mucous membrane is studded by small openings, the *gastric glands*. They are of three varieties and secrete an acid fluid, the *gastric juice*, which contains as its active principles *hydrochloric acid*, *pepsin*, and *rennin*. The pepsin changes proteid substances into a more soluble form, while the rennin has the property of coagulating milk and forming curds.

#### THE SMALL INTESTINE.

The small intestine is that part of the alimentary canal extending from the stomach above to the large intestine below. It is about 22 feet long, and in diameter varies from 1 to 2 inches. It is divided into duodenum, jejunum, and ileum.

The **duodenum** is bent upon itself like a letter U and is that portion of the small intestine leading from the stomach. It forms but a small part of the intestinal canal, being only 10 to 12 inches long. It is, however, much wider than the rest of the small intestine, about 2 inches in diameter, and its walls are also thicker. Opening upon the posterior wall at the middle of the duodenum is the common opening for the bile duct and pancreatic duct.

The **jejunum** is 8 to 9 feet long, has thinner walls than the duodenum, and is smaller, being about 1 1/2 inches in diameter.

The **ileum** is 12 to 13 feet long, has thinner walls than any other part of the small intestine and also is smaller, narrowing toward its end to about 1 1/4 inches in diameter.

**Structure of the Small Intestine.**—Like the stomach it is composed of a serous, muscular, submucous, and mucous layer.

The *serous coat* invests all the intestine except part of the duodenum, and is reflected to the posterior abdominal wall, forming the mesentery, which holds the intestine in place.

The *muscular coat* is in two layers, an inner circular and an outer longitudinal. By the contractions of these muscular fibers, called *peristaltic contractions*, the contents of the intestine are propelled along the canal.

The *submucous* layer contains blood-vessels, lymphatics, and nerves.

The *mucous coat*, or mucous membrane, is thick and vascular in the upper part of the intestine, but thinner below. It is thrown up into numerous folds, the *valvulae conniventes*, and is covered by small vascular projections termed *villi*, from each of which proceeds a lymph vessel, the *lacteal*, which empties into a common duct, the *thoracic duct*.

There are two sets of glands in the small intestine: the *glands of Leiberkühn*, found all through the mucous membrane, and the *glands of Brunner*, found only in the duodenum. In addition, there are found throughout the small intestine solitary lymph nodules; collections of lymph nodules, known as *Peyer's patches*, are also present, chiefly found in the ileum. The secretion from the intestinal glands is an alkaline, yellowish fluid, called *succus entericus*, which has the property of rendering starch and sugar more soluble.

#### THE LARGE INTESTINE.

The large intestine is that portion of the alimentary canal lying between the small intestine and anus. It is 5 to 6 feet long and 2 1/2 inches in diameter at its widest point. It begins upon the right side as a dilated pouch, 2 1/2 to 3 inches long, termed the *cecum*, from which extends a narrow, blind tube, the *vermiform appendix*. The opening for the ileum is guarded by a double valve-like fold of tissue, the *ileo-cecal valve*. From the cecum the large intestine passes up the right side of the abdomen as the *ascending colon*. Upon reaching the liver it makes a sharp turn and passes across the abdomen as the



*transverse colon*. On the left side of the body it passes down as the *descending colon*, and terminates in the *rectum*, which opens externally as the *anus*.

**Structure of the Large Intestine.**—Like the stomach and small intestine it is composed of four coats.

The *serous* and *submucous* coats are of the same structure and have much the same general arrangement as the corresponding coats of the small intestine.

The *muscular coat* consists of internal circular and external longitudinal fibers. A characteristic of the large intestine is that the external longitudinal fibers are collected together into three well marked bands, the *tenia coli*, which begin at the appendix and extend to the sigmoid flexure, beyond which point only two bands are to be found.

The *mucous coat* is rather thin, pale, and thrown into folds, but differs from that of the small intestine in having no villi.

There are solitary lymph nodules in the large intestine and also glands of Leiberkühn.

#### THE LIVER.

The liver is a dark, reddish-brown gland occupying the right side of the abdomen and part of the left, lying below the diaphragm and above the stomach and intestines. It is the largest organ in the body, weighing 50 to 60 ounces, and measures  $8\frac{1}{2}$  to  $9\frac{1}{2}$  inches in its transverse diameter,  $4\frac{3}{4}$  to  $7\frac{1}{4}$  inches antero-posteriorly, and  $6\frac{1}{4}$  inches in its greatest diameter vertically. Its upper surface is convex and is in contact with the diaphragm, while the lower surface is concave and supports the gall bladder.

The **gall bladder** is the pear-shaped receptacle or reservoir for the bile, 3 to 4 inches long, with a capacity of from 8 to 12 teaspoonfuls. It has a duct, the *cystic duct*, leading from its smaller end which is joined by a duct from the liver, the *hepatic duct*, and the two form a single duct, the *common bile duct*, which empties into the duodenum.

**Structure of the Liver.**—The liver is composed of five

lobes and is covered with peritoneum which is reflected on to the diaphragm, forming ligaments which serve to hold the

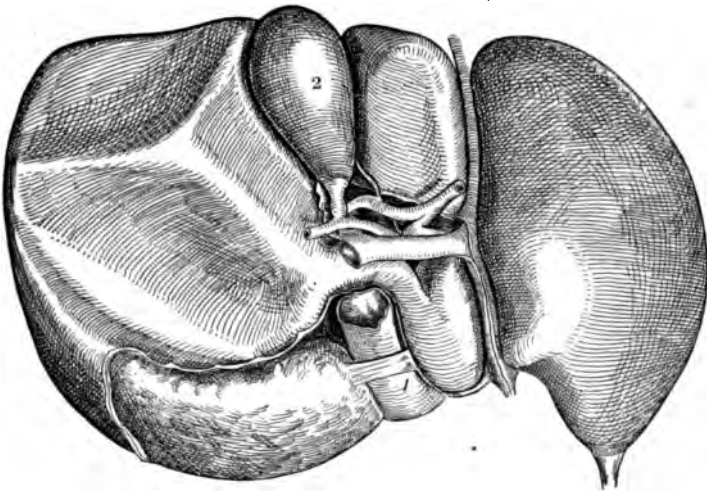


FIG. 52.—The liver, seen from below. 1, Inferior vena cava; 2, gall bladder.

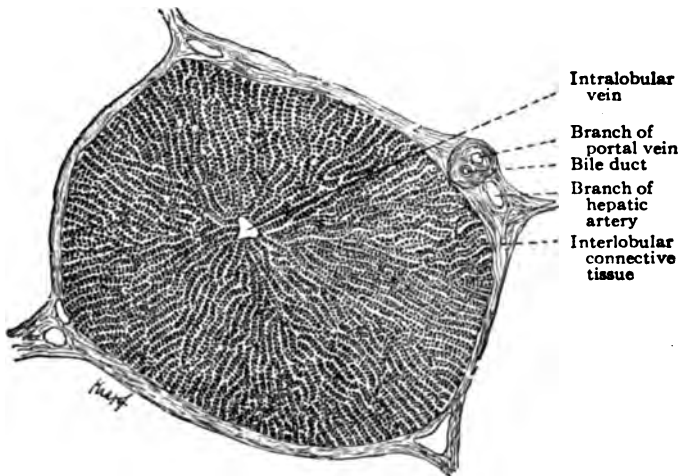


FIG. 53.—Section through liver of pig, showing chains of liver-cells.  $\times 70$  (Böhm and Davidoff).

organ in place. Each lobe is composed of a number of lobules, which in turn consist of a collection of liver cells arranged

around a central vein, the *intralobular vein*. Thus the blood circulating through the liver is brought in contact with the liver cells.

The liver has the important function of secreting *bile*, of manufacturing a substance called *glycogen*, which is readily converted into sugar, and of forming certain waste matter, called *urea*.

The bile is a yellow or yellowish-brown alkaline fluid, with a very bitter taste, having the property of emulsifying fats.

#### THE PANCREAS.

The pancreas, or sweetbread, is a narrow, elongated gland, 6 inches in length, 2 inches broad, and 1 inch thick, weighing 2 to 3 ounces. It extends transversely across the abdomen,

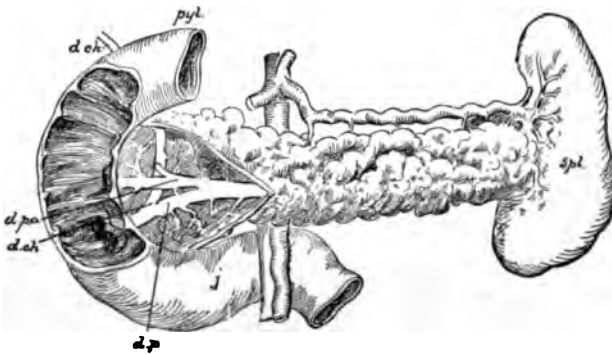


FIG. 54.—Pancreas dissected to show (*d. p.*) pancreatic duct; *d. pa.*, accessory duct; *d. ch.*, bile duct; *spl.*, spleen; *j.*, jejunum (modified after Robson and Moynihan.)

the greater portion of it lying on the left side behind the stomach and intestines. From its interior leads a duct, the *duct of Wirsung*, which opens into the duodenum in the same opening with the common bile duct (Fig. 54).

The pancreas secretes a slightly viscid, alkaline fluid, which has the property of converting starch into sugar, of emulsifying fats, and of rendering porteid substances soluble.

## FOOD AND DIET.

The human body is constantly undergoing waste, its tissues being destroyed, or burnt up, so to speak, in furnishing heat and energy. The wasting of the tissues goes on continually, even during sleep when the body is at rest, but is more marked during the active exercise of brain or muscle. To furnish the tissues with a source of heat and energy and to make good the waste that is constantly going on, certain materials, known by the name of *foodstuffs*, must be taken into the body daily in a definite amount. If this is not done, the tissues themselves are called upon to supply all the heat and energy, with the result that a rapid wasting ensues, the body loses weight, and finally a condition of starvation occurs. The foodstuffs are classified as follows:

**Proteids**, or nitrogenous foods, such as fatless meats and the white of eggs, contain carbon, hydrogen, oxygen, and nitrogen. They are absolutely necessary for the maintenance of nutrition, as it is from them that new tissues are formed and old tissues repaired. In addition proteids furnish the source of some of the heat and energy supplied to the body.

**Carbohydrates**, such as starches, sugars, and gums, predominate in vegetable foods and contain carbon, hydrogen, and oxygen, but no nitrogen. They are destroyed in the body and liberate a certain amount of heat and energy.

**Fats**, such as all vegetable and animal fats, like the carbohydrates, contain carbon, hydrogen, and oxygen, but no nitrogen. They have practically the same use as the carbohydrates. The fats and carbohydrates are sometimes called the non-nitrogenous foods.

**Water and Salts.**—These substances are absolutely necessary for the body, yet in a free state are not considered vital foods, because nearly all foods contain water and salts in a greater or less amount.

A suitable diet, then, for an adult should consist of food composed of water, salts, proteids, carbohydrates, and fats, or, in other words, should contain the same elements of which the

body is composed. Without proteids the body will waste, because there is nothing in the other foodstuffs to supply nitrogen, so necessary to the tissues. A person can exist on a proteid diet alone, but a very large quantity of proteid material would have to be consumed to obtain the necessary heat and energy, thus throwing a lot of unnecessary work upon the digestive organs. From this it is evident that a mixed diet, containing the three chief ingredients—proteids, carbohydrates, and fats—in such an amount as not to be in excess of the needs of the body, is not only the most nutritious diet, but is also most the economical for the tissues.

#### DIGESTION.

The material taken into the body as food, while containing the necessary principles for nutrition, is often in an insoluble form and of a composition far different from the tissues it is to build up or repair. It thus becomes necessary that all foods should be digested or, in other words, changed into such form that they can be easily absorbed and at the same time furnish the necessary nourishment for the tissues.

When the food is taken into the mouth it is thoroughly ground and chopped up by the teeth. At the same time the salivary glands begin to secrete a large quantity of saliva, which moistens the mouth and food and thoroughly mixes with the latter. The food thus becomes converted into a semisolid mass and all portions of it are exposed to the action of the saliva, while the insoluble, starchy constituents commence to be converted into a more soluble sugar, maltose. The *bolus*, as the food now thoroughly masticated and mixed with saliva is called, passes back into the pharynx, but is prevented from getting into the nose by the soft palate; it is pushed farther back by the tongue, and, passing over the larynx, which is closed by the epiglottis, is then grasped by the muscular walls of the pharynx and pushed on into the esophagus. This tube then begins to contract from above downward and propels the bolus along into the stomach.

As soon as the stomach receives the food, an abundant secretion of gastric juice is poured out by the gastric glands, and the organ commences to contract. The food is thus churned up and thoroughly mixed with the acid gastric juice until it resembles a thick pea-soup, and is now known as the *chyme*. The gastric juice through its acidity soon prevents any further digestion of the starches, which as we have seen commenced in the mouth, but it acts upon the proteids, however, changing them into more soluble substances, the *peptones*. Most of the chyme passes out into the duodenum through the pylorus, but a small part of it—some of the soluble sugars, water, and peptones—is probably absorbed directly by the blood-vessels of the stomach wall.

As the chyme passes into the duodenum, the bile and pancreatic juice is poured out and mixes with the acid chyme, converting it into an alkaline mixture, the *chyle*. The secretions from the liver and pancreas, with those from the intestinal glands themselves, act on any proteids that remain undigested, converting them into more soluble substances. At the same time the conversion of starch into sugar, which was interrupted while the food was in the stomach, is continued. Finally, fats and oils are emulsified or broken up into minute drops, in which form they are more readily absorbed. As the chyle is forced along the intestine by its contractions, the digested proteids and carbohydrates are absorbed directly by the blood-vessels of the intestine, while the fine fat globules, not being dissolved, cannot pass directly into the blood but first enter the lacteals of the villi, then pass into the thoracic duct, and eventually enter the blood through the left subclavian vein.

When the digested matter with the undigested residue reaches the large intestine it is in a fluid condition, but, during its passage through this canal, the fluids, as well as any dissolved substances which may have escaped absorption in the small intestine, are absorbed. The contents of this portion of the bowel are thus gradually converted into a solid mass, and by

the time it reaches the rectum it is dark in color, has a characteristic odor, and is known as the *feces*.

To sum up the process of digestion, we may say that the carbohydrates only are digested while the food is passing to the stomach; that in the stomach the ptyalin swallowed with the food continues to digest the starches for a time and that proteids are also digested here, and a small quantity of water, soluble proteids, and carbohydrates are probably absorbed; that in the small intestine carbohydrates, proteids, and fats are all digested and absorbed; and that in the large intestine a further absorption of those substances and of the fluids occur.

## CHAPTER VII.

### THE EXCRETORY SYSTEM.

**Excretion** is the process of removal of the waste of the tissues from the body. These waste products are carbonic acid, salts, urea, and water. They are continually poured into the blood as it circulates through the capillaries, and the blood rids itself of these products through the lungs, skin, and kidneys; these organs in turn have the function of eliminating waste products from the body.

**The Lungs as Excretory Organs.**—The anatomy of the lungs has already been described (page 78).

As excretory organs they remove from the body a large quantity of carbonic acid and a small quantity of water, part of the fluid exhaled probably coming from the moisture of the nostrils.

**The Skin as an Excretory Organ.**—For the structure of the skin see page 47.

Its secretion, the sweat or perspiration, is a colorless fluid with a salty taste and peculiar odor, in which are excreted water, certain salts, carbonic acid, and urea. The amount of carbonic acid given off by the skin is less than  $1/100$  part of the amount given off by the lungs, and but very small quantities of urea are normally eliminated by this route.

There is always a little perspiration being excreted, though we may not be conscious of it, the average amount in twenty-four hours being about 2 pounds (pints); it may, however, only amount to a few ounces. The perspiration may be so scant that it immediately evaporates, leaving no visible residue upon the skin; this is known as *insensible perspiration*. If, on account of an increase in the quantity of fluid perspired or on account of



the temperature, the perspiration does not evaporate but remains in drops upon the skin, it is called *sensible perspiration*. Any condition causing the blood to circulate freely through the skin will cause an individual to perspire more freely. After eating, after violent exercise, or in hot weather, a large amount of perspiration is excreted. On the other hand, early in the morning and in very cold weather when the skin is less active, but little perspiration is lost. The amount excreted also depends upon the quantity of fluids a person takes.

The function of the sweat glands is to regulate the temperature of the body. Under the influence of high degrees of heat the sweat glands are stimulated. They pour out an increased amount of fluid which rapidly evaporates and thus cools off the surface of the body. For this reason a dry atmosphere of high temperature can be borne more readily than an atmosphere of even lower temperature laden with moisture. In the first instance evaporation of moisture readily occurs; in the latter case evaporation is interfered with, and the body rapidly becomes overheated.

#### THE KIDNEYS.

The kidneys are two bean-shaped glands lying behind the peritoneum upon the posterior abdominal wall on either side of the spinal column. The left kidney is situated on a higher level than the right. They are reddish-brown in color and measure about 4 inches in length, 2 to 3 inches in width, and 1 to 1 1/2 inches in thickness.

Leading from each kidney is its excretory duct, the *ureter*. This is a tube about 18 inches long and the size of a goose-quill which passes down along the posterior abdominal wall into the pelvis and terminates in a musculo-membranous sac or reservoir, the *bladder*.

**Structure of the Kidney.**—The kidney consist of an outer *cortical part* and an inner portion, the *medulla*. Its substance is composed of a number of Malpighian bodies and uriniferous tubules.

The **Malpighian bodies** are situated in the cortex of the kidney and consist of a tuft of blood-vessels, the *glomerulus*, and an expansion of the uriniferous tubule which forms a capsule, or covering, about the glomerulus. The glomerulus is composed of a small afferent artery, which breaks into a number of twisted capillaries, and these in turn unite to form a single efferent vessel which enters capillaries surrounding the uriniferous tubules.

The **uriniferous tubules**, after leaving the Malpighian body, coil around and change their direction a number of times, finally emptying into the ureter.

By this arrangement of the blood-vessels the arterial blood is brought directly to the glomerulus, through which it passes and then supplies the uriniferous tubules. It is while circulating through the glomerulus that the blood gets rid of some of its fluid constituents by a process of filtration, while the solid waste products are excreted by the uriniferous tubules. The carbonic acid, salts, urea, and water finally pass into the tubules and are discharged from the kidneys into the ureters in the form of urine.

The urine is a pale, amber, yellowish liquid with an acid reaction, having a salty taste, and containing about  $1/20$  of its weight of solids. It is excreted continuously by the kidneys, and trickles drop by drop into the bladder until a sufficient quantity has accumulated to distend that organ and cause an uneasy sensation to be felt by the individual, when it is discharged by contraction of the bladder. In a normal person about 50 ounces of urine are excreted daily, but the amount varies in different individuals, depending upon the quantity of

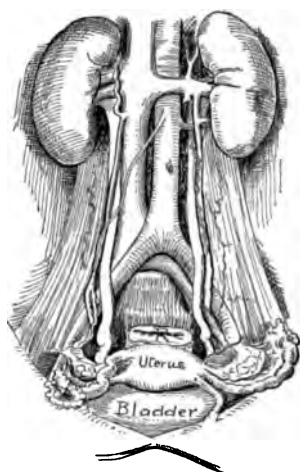


FIG. 55.—Kidneys, ureters, and bladder (Macfarlane).

fluid swallowed, upon the food, upon the external temperature, and upon the amount one perspires.

As eliminators of water, the kidneys may be considered as accessories of the skin, the amount of water they excrete

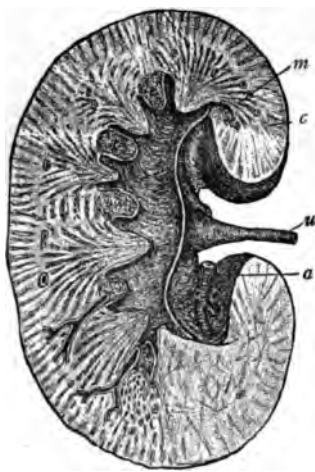


FIG. 56.—A longitudinal section of the kidney. *a*, Renal artery; *c*, cortex; *m*, medulla; *u*, ureter (Leroy).

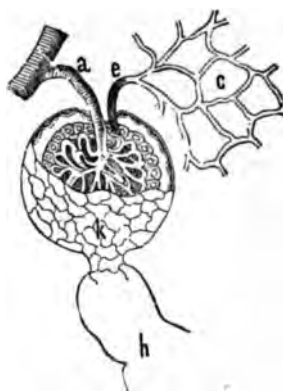


FIG. 57.—A Malpighian body or corpuscle. *a*, Afferent artery; *e*, efferent vessel; *c*, capillaries; *k*, commencement of uriniferous tubule; *h*, uriniferous tubule (Leidy).

depending upon that excreted by the skin,—that is, the less the amount lost through the skin, the more will be excreted by the kidneys. The amount of solids excreted, however, has little to do with perspiration, being dependent entirely upon the waste going on in the body.

## CHAPTER VIII.

### THE NERVOUS SYSTEM.

The nervous system is made up of a series of units, *neurons*, each of which consists of a cell body with short branching processes, the *dendrites*, and a single long process, the *neuraxis* or *axon*, which is prolonged into a nerve fiber (Fig. 58). While not anatomically continuous with each other, the neurons communicate by contact through their dendrites and axons. The whole nervous system may thus be described as a chain of nerve cells which are in close relation with one another, but, at the same time, extend by means of branches—their nerves—to all parts of the body. In this way the different systems of the body keep in touch with one another, and the functions and workings of the organs comprising these systems are controlled and regulated.

The elements composing the nervous system are nerves and nerve centers.

The **nerves** are simply round cords consisting of nerve fibers which form connections between the centers and distant points. They have the function of conveying and transmitting nervous impulses and are of two kinds, according to the function they perform. Those that convey impressions from their peripheral terminations to their centers are spoken of as *sensory* nerves. Those that transmit impulses from these centers to the parts with which they are connected are known as *motor* nerves.

The **nerve centers** are composed of several nerve cells, or a large collection of cells, and are distributed through the brain,

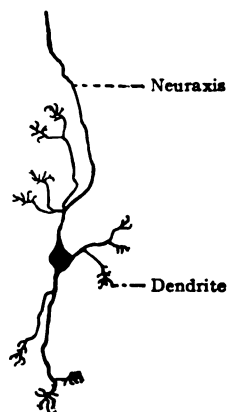


FIG. 58.—Nerve cell.  
× 100 (Böhm and Davidoff).

spinal cord, and ganglia. Their function is to recognize and dispose of impressions received through the sensory nerves.

For convenience of description the nervous system is usually divided into the *cerebrospinal* and the *sympathetic system*. The former is composed of large nerve centers, the brain and spinal cord (cerebrospinal axis), and nerves given off from these centers; while the sympathetic system is composed of a series of small centers, termed *ganglia*, and nerves connected with these ganglia.

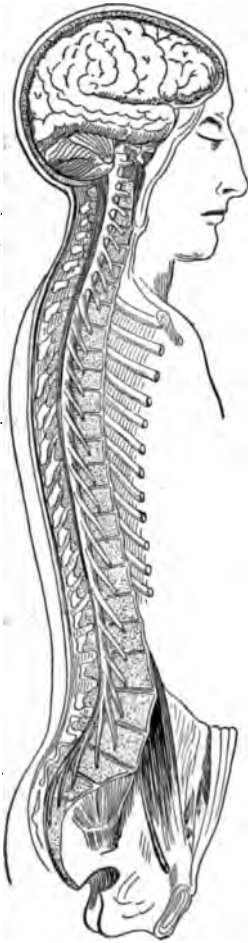


FIG. 59.—General view of the cerebrospinal nervous system (after Bourguery; Schwalbe).

#### THE CEREBROSPINAL SYSTEM.

##### THE BRAIN.

The brain is that part of the cerebrospinal axis inclosed within the skull. It weighs about 50 ounces, being nearly as heavy as the liver, but much smaller in size. As a rule the size of the brain is in proportion to the intellectual capacity of the individual. It is composed of gray and white matter, the former consisting chiefly of nerve cells, while the latter consists of nerve fibers. Its surface is divided by a great many small fissures, lying between which are masses of gray matter, the *convolutions*.

The brain is separated from the bony walls of the cranium by three membranes: an outer, of tough fibrous tissue, closely adherent to the interior of the skull, the *dura mater*; a middle, a thin, delicate membrane, called the *arachnoid*; and an inner, a vascular covering which closely

envelops the surface of the brain, the *pia mater*. Between the arachnoid and pia mater is a space filled with fluid, the *cerebrospinal fluid*. The brain consists of four main portions: the *cerebrum*, *cerebellum*, *pons varolii*, and *medulla oblongata*.

The **cerebrum**, occupying the uppermost portion of the cranium, comprises the greater part of the brain. It is divided from before backward into two halves, the *hemispheres*. Externally, it consists of gray matter thrown into many convolu-

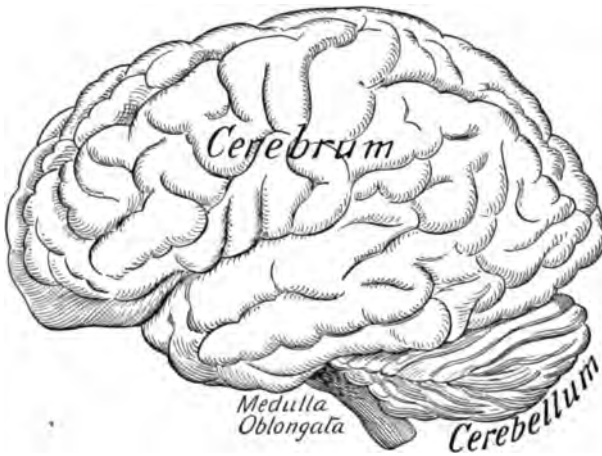


FIG. 60.—The brain.

tions which increase its surface area without taking up additional space. Interiorly, it is composed of white matter.

The cerebrum is the seat of the intellect, volition, ideas, emotions, and motor actions.

The **cerebellum**, or small brain, is situated behind and below the cerebrum. It consists of two hemispheres, the gray and white matter having the same arrangement as in the cerebrum. Its surface, however, is not convoluted, but is marked by numerous furrows.

The cerebellum is not concerned with the intellectual functions, but regulates and coördinates the contractions of muscles.

The **pons varolii**, or bridge of Varolius, is a thick band

of nerve tissue, consisting chiefly of white matter, which passes around in front of the medulla and connects the two hemispheres of the cerebellum, and also forms a path of communication between the cerebrum and medulla oblongata.

The pons serves as a means of communication between the higher parts of the brain and the spinal cord.

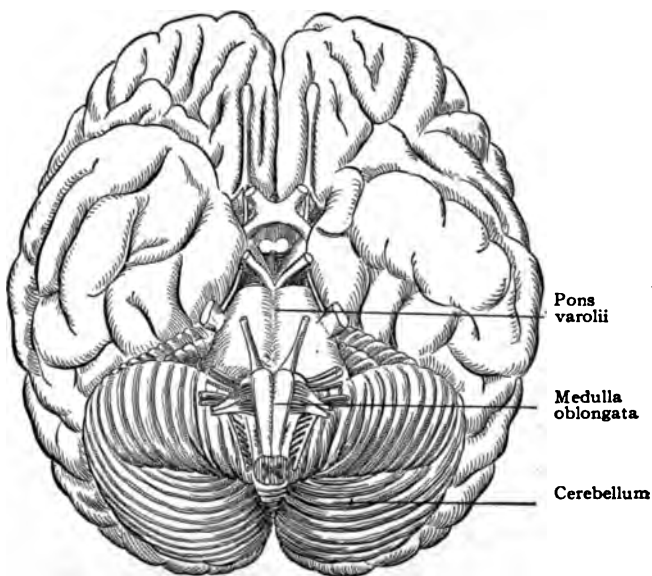


FIG. 61.—Base of the brain.

The **medulla oblongata** is the lowermost division of the brain. Its upper surface is connected with the pons varolii, while its lower surface passes insensibly into the spinal cord. It is composed of white and gray matter, the former situated externally and the latter internally.

The medulla transmits all of the nerves passing between the brain and spinal cord. It is also the seat of certain involuntary acts, as swallowing, vomiting, and breathing, and has centers which control the blood-vessels and heart.

## THE SPINAL CORD.

The spinal cord is the terminal portion of the cerebro-spinal axis occupying the upper two-thirds of the spinal column. It is 17 to 18 inches long and nearly cylindrical in form. Above it is continuous with the medulla; below it terminates opposite the first lumbar vertebra in the form of a cone, the *conus medullaris*, from which extends a fine prolongation, the *filum terminale*. It is composed of white matter externally, and gray matter internally. The white matter consists of motor and sensory nerves, the former running in the anterior part of the cord, while the latter occupy the posterior. Nearly all the nerves supplying the voluntary muscles below the head arise from the cord, while the sensory nerves from these same regions enter it. Surrounding the cord are continuations of the same three membranes which envelop the brain.

The cord serves to convey impressions received through its sensory nerves to the brain and, in response to these impressions, transmits from the brain motor impulses. It also possesses the power of originating motor impulses in response to certain stimuli, and so can, at times, act as a nerve center itself, independently of the brain. For example, if the hand be placed in the fire a sensation of pain is produced, and this sensation is conveyed by the sensory nerves supplying the part to the spinal cord, in response to which the cord sends out a motor impulse to the muscles of the arm, with the result that they contract and the hand is quickly withdrawn. Now, this impulse sent out from the cord was produced entirely independent of any action of the brain, and did not originate from the will or volition, but in response to an outside stimulus. This power possessed by the cord is known as that of *reflex action*.

## CEREBROSPINAL NERVES.

The cerebrospinal nerves are those which arise from some portion of the brain or spinal cord. They are divided



into the cranial and the spinal nerves. Some are sensory; some are motor; and others are composed of both sensory and motor fibers, termed *mixed* nerves.

**The Cranial Nerves.**—These are twelve pairs of nerves which arise from centers in the brain and pass out of the skull through openings in its base.

The *first pair*, the *olfactory*, are the nerves for the special *sense of smell*, and supply the interior of the nose.

The *second pair*, the *optic*, are the nerves for the special *sense of sight*, and are distributed to the eyes.

The *third pair*, the *oculo-motor*, and the *fourth pair*, the *trochlear*, are both *motor* nerves supplying most of the muscles of the eyes.

The *fifth pair*, the *trifacial*, are *mixed* nerves, the sensory fibers supplying the skin of the face, the teeth, the tongue, and the mucous membrane of the mouth, nose, and eyes, the motor fibers supplying the muscles of the jaws.

The *sixth pair*, the *abducent*, are *motor* nerves for the external muscles of the eyes.

The *seventh pair*, the *facial*, are *mixed* nerves, the motor fibers supplying the muscles of the face, and small sensory fibers supplying a part of the tongue.

The *eighth pair*, the *auditory*, are the nerves for the special *sense of hearing*, and for equilibration.

The *ninth pair*, the *glosso-pharyngeal*, are *mixed* nerves. They are the nerves for the special *sense of taste*. Sensory fibers are distributed to the mucous membrane of the middle ear, tongue, and pharynx and motor fibers to one of the muscles of the pharynx.

The *tenth pair*, the *pneumogastric*, are *mixed* nerves, supplying motor and sensory fibers to the pharynx, larynx, trachea, lungs, heart, esophagus, stomach, intestines, and liver. Special sensory fibers are also distributed to the spleen, pancreas, kidneys, suprarenal bodies, and intestinal blood-vessels.

The *eleventh pair*, the *spinal accessory*, are *motor* nerves, supplying through the spinal portion certain muscles of the

back and neck. The other fibers unite with the pneumogastric.

The *twelfth pair*, the *hypoglossal*, are the *motor* nerves for the muscles of the tongue.

**The Spinal Nerves.**—There are 31 pairs of nerves arising from the spinal cord called the *spinal nerves*. They take origin from each side of the cord by two roots. The anterior roots contain motor fibers from the anterior part of the cord, the posterior roots spring from the posterior part of the cord, and contain sensory fibers. The two roots unite and pass out of the spinal column as mixed nerves. They then divide into anterior branches which supply the anterior portions of the trunk and all the extremities, and posterior branches which supply the posterior portions of the trunk. Both branches are composed of sensory and motor fibers.

#### THE SYMPATHETIC SYSTEM.

The sympathetic system consists of two chains of small nerve centers, the *sympathetic ganglia*, situated on each side of the spinal column, communicating with each other and with the cerebrospinal nerves by nerve fibers and distributing

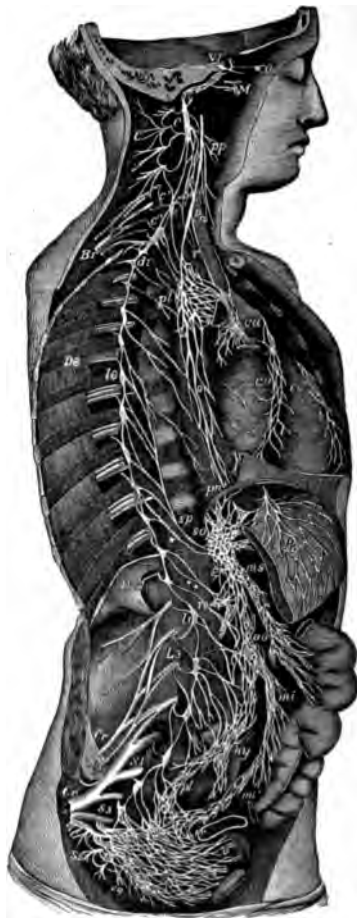


FIG. 62.—Diagrammatic view of the sympathetic cord of the right side, showing its connections with the principal cerebrospinal nerves and the main preaortic plexuses. (Reduced from Quain's Anatomy.)

branches to the blood-vessels and internal organs, as the heart, lungs, alimentary tract, secreting glands, etc. This system of nerves presides over and controls the vital functions and, while connected with the cerebrospinal system, yet is not under the control of the will and acts independently, so that when the brain ceases to work, as in sleep, unconsciousness, or paralysis, the vital organs can continue their work unaffected.

The sympathetic system has the same power of receiving and transmitting impulses and of participating in reflex actions as has the cerebrospinal system. Blushing may be taken as an example of the latter. Some mental emotion—it may be caused by pleasure, anger, pain, or shame—affects the sympathetic nerves which control the blood-vessels of the face, with the result that they enlarge, more blood circulates through the face, and the skin becomes hot and red. Upon some people fright may have this same effect and upon others just the opposite effect, causing the blood-vessels of the face to contract, or grow small, with the result that the skin becomes pale and white. As still another example of this reflex action of the sympathetic system, the presence of food in the stomach will cause impressions to be felt by the ganglia which preside over that organ and result in contractions in the stomach wall and a profuse secretion from the digestive glands.

That the sympathetic system is in close relation with the brain and spinal cord is well illustrated by the convulsions frequently produced in young children from slight digestive disturbances. The convulsions are often caused by an irritation from particles of undigested material remaining in the intestines. The irritating effect of this material is first felt by the sympathetic nerves supplying these organs, impulses are then transmitted to the cerebrospinal system and brain, and as a result convulsions occur.

**PART II.**  
**BANDAGES, DRESSINGS, PRACTICAL**  
**REMEDIES, ETC.**

**CHAPTER IX.**

**BANDAGES AND SLINGS.**

**BANDAGING.**

The two types of bandage in general use are the roller bandage and the handkerchief, or triangular, bandage. Of the two the former is probably more universally used, as it can be quickly and easily applied, and, when properly adjusted, it certainly forms a very neat and well-fitting dressing. The handkerchief bandage, on the other hand, is more applicable to emergency cases and is frequently used upon the field for temporary dressings or for making slings.

Bandages have many uses, but they are commonly employed for the purpose of retaining dressings and splints, for controlling hemorrhage, and as a means of furnishing protection or support to different portions of the body.

Gauze and unbleached muslin are the materials from which most bandages are made, but for special purposes flannel, crinoline, silk, elastic webbing, and rubber may be utilized. Whatever the material used it should be firm of texture and free from any wrinkles or creases. The material should never be pieced, as such bandages are not only rough and unsightly in appearance, but they may do actual harm by exerting undue pressure upon the parts beneath.

**THE ROLLER BANDAGE.**

A roller bandage consists of a strip of muslin or other material rolled in the form of a cylinder, so as to be in a convenient shape for application. It may be described as consist-

ing of an initial end, a body, and a terminal end. When the bandage is rolled from one extremity only it is known as a single roller. When the bandage is rolled from both extremities toward the center, it is known as a double roller, forming a bandage consisting of two cylinders.

Bandages vary in length from three to twelve yards, and in width from one to six inches. For the fingers and toes they



FIG. 63.—Method of rolling a bandage.

should be about one inch wide and three yards long; for the extremities, two to two and one-half inches wide and about six yards long; and for the trunk, a bandage should be four to six inches wide and twelve yards long.

Roller bandages of any width and size may be procured at most drug stores or from dealers in surgical supplies, but, if desired, they may readily be made as described below.

**To Roll the Bandage.**—The material is torn into the required width, the selvedge having been previously removed. The strip is then rolled by first folding one end upon itself several times until a small core or cylinder is formed. When this cylinder is of sufficient size to allow of its being grasped at each end between the thumb and forefinger without collapsing, it is held by the left hand lightly in this position while the right hand is used as a guide, the cylinder being made to revolve in the left hand, as shown in the accompanying illustration (Fig. 63). This process is continued until the bandage has been entirely rolled. Care must be observed in rolling to avoid wrinkling the material, and to roll it evenly and firmly. When a large number of bandages are required in hospitals much time is saved by using a machine especially adapted for this purpose. In this way a whole bolt of muslin may be rolled at once and afterward cut with a knife into the required widths.

**The Application of the Bandage.**—To properly apply a bandage, first face the patient, then, grasping the body of the bandage in the right hand with its initial or free end in the left hand, place the outer surface of the free end upon the part to be bandaged and hold it in place with the fingers of the left hand, while the right hand carries the roll around the limb, finally coming back to the starting-point. This first turn is repeated several times, and is termed “fixing the bandage.” After this the bandage will not slip, and the left hand may then be removed and can be used alternately with the right hand in carrying the roll around the limb.

**To Secure the Bandage.**—Having completed the bandage, its extremity must be made secure. This can be done by pinning, sewing, tying, or by means of adhesive straps.

If a bandage is pinned with straight pins, be careful to insert the pins downward and to bury the points in the substance of the bandage. This prevents the points of the pins from catching in the clothing or otherwise doing harm.

While pinning and sewing are the safer methods, as a

knot may cause discomfort from pressure upon the tissues, there are many occasions when pins and needles are not available, and in such cases it is necessary to tie the bandage. This may be done by tearing the terminal end for several inches into two tails. These two tails are tied once to prevent any further tearing, and are then carried around the limb from opposite directions, and, when they meet, are tied. A quicker way, however, is to leave about eighteen inches of the bandage free. This is grasped in one hand at about two-thirds the distance from its end, while the other hand carries the remaining portion around the limb in the opposite direction. This leaves two ends to tie, one consisting of the double strip of muslin, and the other of the single end.

Adhesive plaster may be employed to secure the bandage by simply using a small strip to fasten the loose end to the body of the bandage.

**To Remove the Bandage.**—A bandage may be simply cut off a part or it may be unwound. For cutting the band-



FIG. 64.—Bandage scissors (Fowler).

age, a special form of scissors with a protected point, as shown in Fig. 64, should be employed; with such an instrument injury to the tissues beneath the bandage is guarded against.

To unwind a bandage, first free its extremity. The free portion of the bandage is then collected in one hand, being transferred from one hand to the other as the unwinding progresses. This is necessary to avoid entangling the bandage about the part from which it is being removed and also to prevent the bandage from being soiled by contact with the floor. If it is desired to employ the bandage over again it may then be rolled as described above.

**Hints on Applying Bandages.**—While the art of applying bandages can only be acquired by diligent practice, still there are a few rules and some few cautions that should be observed.

To begin with, always apply the bandage while the limb is in the position it is to remain in after the bandage is on. For example, a spica bandage should not be applied to the shoulder when the arm is at right angles to the body; later, when the arm is allowed to hang by the side, the change of position is sure to tighten the bandage and make it exceedingly uncomfortable for the patient.

When a bandage is applied to a limb simply for support, it should, if possible, be begun at the extremity of the part and be carried upward toward the body; otherwise, the part below the bandage is apt to swell and the bandage then acts as a constricting band, and strangulation of the part may follow. As a general rule it is wise to leave the fingers and toes exposed, as they furnish an excellent indication of the condition of the circulation in the limb and show whether a bandage is applied with too much tension. Should the part below the bandage become cold and blue after its application *the bandage should be immediately removed*, as this is an evidence of its being on too tight.

The beginner will find it a very difficult matter to determine just how much tension to use in applying the bandage. Of course much depends upon one's experience and skill and upon the object for which in a given case the bandage is employed. Still, there are a few observations which if kept in mind may be helpful. It should be remembered that hard, infiltrated tissues are capable of standing a considerable amount of tension. The same is true of boggy, edematous tissues. But inflamed tissues and the soft, flabby tissues of children can bear but little pressure. Bandages applied over splints can be put on with considerable tension, as most of the force is expended upon the splints, and the whole circumference of the limb is not subjected to pressure. Where there are heavy, yielding dressings more tension will be necessary to afford the same support than if



there were none present. Wet bandages must be used with caution, as they are liable to shrink upon becoming dry. For this reason the plaster bandage is simply *laid* on, no force being used, the pressure, if any, being supplied by the bandage beneath the plaster. It should be kept in mind that the greater the circumference of the part to be bandaged the more tension is necessary. Thus, in bandaging a limb, each succeeding turn as it ascends should be applied with a *very little* more tension in order to get the same degree of support. It should also be remembered that each additional turn of a bandage upon the same region causes nearly double the amount of pressure, hence the turns should be uniform in number over the whole part, overlapping equally, and should be applied evenly and with the same amount of firmness.

**Forms of Roller Bandages.**—Roller bandages may be classified as follows: Circular, oblique, spiral, spiral reversed, figure-of-eight, spica, and the recurrent bandage.



FIG. 65.—Circular bandage (Fowler).

**The Circular Bandage** consists of several repeated turns which exactly overlies each other (Fig. 65). It is used to fix the initial end of a bandage, and

also to retain dressings and compresses.

**The Spiral Bandage.**—In a spiral bandage each turn about the limb ascends higher and overlaps one-half to two-thirds the preceding turn with its lower edge (Fig. 66). This bandage is only applicable to a part of uniform circumference. If applied to a conical part, the bandage will fit tightly at one edge and lie loosely at the other, thus failing to exert uniform compression, besides presenting an unsightly appearance and being easily displaced.

**The Oblique Bandage** is applied in the same way as a spiral,

only the turns are separated from each other by a considerable



FIG. 66.—The spiral bandage.

space (Fig. 67). It is used to retain splints and to hold dressings lightly in place.

**The Spiral Reversed Bandage** consists of an ordinary spiral bandage with reverses. It is applied as a spiral until the turns commence to lie loosely. A reverse is then made by placing a finger of one hand upon the free edge of the bandage at the point selected for making the reverse, while the hand holding the roll is pronated. The result is that the turn now pursues a different course; if it was previously going up the limb, after the reverse it goes down (Fig. 68). The roll is then carried on around the limb, and, on reaching the opposite side, firm traction is made with the result that the turn will apply itself smoothly to the part. The reverses should all be made in the same line, and care must be taken that they do not fall over bony prominences. The spiral reversed bandage is used as a means of support and to retain dressings and splints.



FIG. 67.—The oblique bandage.

**The Figure-of-eight Bandage** consists of a series of oblique turns which cross in the form of a figure-of-eight. Each turn overlaps two-thirds of the preceding turn, alternately ascending and descending (Fig. 69). It is used especially about the knee- and elbow-joints to furnish support and retain dressings.

**The Spica Bandage** is used about the groin, shoulder, foot, and hand. Applied to the groin or shoulder, the bandage is first made secure by several circular turns about the limb.



FIG. 68.—Method of making a reverse (Fowler).

The roll is then carried obliquely up the limb and around the trunk, and, on coming down the limb upon the opposite side, it intersects the first turn forming an angle or spica. Each turn follows the preceding turn, overlapping two-thirds of it. The spica is spoken of as ascending or descending, according to whether the turns overlap from below upward or from above downward.

**The Recurrent Bandage** is used to retain dressings upon the head or upon the stump of a limb. The part is covered



FIG. 69.—Application of a figure-of-eight bandage.



FIG. 70.—Application of a spica bandage.

by turns which recur successively to the point of starting, and



FIG. 71.—The application of a recurrent bandage.

each recurring turn overlaps two-thirds of the preceding turn. The ends of the turns are covered and held securely in position by circular turns.

#### BANDAGES FOR THE HEAD.

##### The Recurrent Bandage of the Head.

—A roller two to two and a half inches wide and about seven yards long will be required.

The initial end is placed upon the fore-

head, and is held in place by the left hand while the right hand carries the bandage around the head and back to the starting-point.

This circular turn is repeated twice. On reaching the forehead the third time, the thumb or fingers of the left hand are placed upon the bandage, and at this point a right-angled reverse is made (Fig. 71). The roll is then carried across the median line of the head from in front to the back of the head. An assistant



FIG. 72.—Recurrent bandage of the head completed.

holds the bandage at this point, while the turn is made to recur to the forehead covering two-thirds of the first turn and converging to the starting-point. The roll is again carried to the back of the head, overlapping two-thirds of the first turn upon the opposite side. These turns are repeated until the whole head is covered. Another right-angled reverse is then made, and several circular turns are carried around the head to fix the ends of the reverses (Fig. 72). The bandage may be secured by pinning or tying. Pins must also be inserted in front and behind to hold the reverses in place.

**Uses.**—To retain dressings and compresses upon the head.

**Figure-of-eight Bandage of the Eye.**  
—A roll two to two and a half inches wide and five yards long is required.



FIG. 73.—Figure-of-eight bandage of one eye.

If the right eye is injured, bandage from left to right; if the left eye is to be covered, bandage from right to left. After fixing the bandage by two circular turns around the head, place the thumb of the left hand upon the bandage behind and make a right-angled reverse, carrying the roll down below the ear of the injured side and up across the eye to be covered. Continue up over the opposite side of the skull and back to the point of starting. Repeat this turn several times, and finally make several circular turns about the head (Fig. 73). To prevent slipping, the bandage should be pinned at the points of intersection.

**Uses.**—To retain dressings and compresses upon the eye.

**Figure-of-eight Bandage of Both Eyes.**—Use a roll two to two and a half inches wide and seven yards long.



FIG. 74.—Figure-of-eight bandage of both eyes.

Fix the bandage by two circular turns about the head, passing from right to left. Make a reverse and carry the roll down over the left eye, across the cheek, under the left ear, around the neck, and up over the right eye to the starting-point. Make another reverse and continue around the head, and then repeat the first turn, overlapping the previous turn. The bandage is completed

by two circular turns around the forehead (Fig. 74).

**Uses.**—To retain dressings and compresses upon both eyes.

**Barton's Bandage.**—Use a roll two to two and a half inches wide and five yards long.

The initial end is placed behind the ear of the sound side and is held by the thumb of the left hand, while the roll is carried down under the back of the head, up behind the ear of the injured side, and over the skull. From here it passes down the sound side of the face, in front of the ear, under the chin,



FIG. 75.—Barton's bandage.

and up the injured side of the face to the top of the skull, where it crosses the first turn. It is then continued down behind the ear of the sound side, around the neck, over the chin, and to the back of the head. Repeat these turns twice and secure the bandage by pinning or sewing (Fig. 75).

**Uses.**—To hold the fragments of a fractured jaw in place and to retain dressings upon the chin and back of the neck.

**Gibson's Bandage.**—A roll two to two and a half inches wide and five yards long will be required.

Gibson's bandage consists of three series of circular turns. Start the roll down the sound side of the face and make three circular vertical turns, passing in front of the ears, around the face, under the chin, and up over the top of the skull. With the thumb of the left hand over one temple hold the bandage in position and make a right-angled reverse. The bandage then passes downward below the back of the head, across the forehead, and back to the point of starting. This circular turn around the head is repeated three times. On reaching the back of the head the third time, the bandage is carried forward beneath the ears, around the chin, and again to the back of the head. Repeat this turn three times and, on reaching the back of the head the last time, make a right-angled reverse and carry the roll up over the head to the forehead (Fig. 76). Secure the bandage by pinning all the points of intersection.



FIG. 76.—Gibson's bandage.

**Uses.**—As a dressing for fractured jaw.

**The Knotted Bandage.**—A *double* roller two and one-half inches wide and seven yards long will be required.



Place the portion of bandage lying between the two rolls upon the temple of the injured side. Then carry the two rolls from opposite directions around the head and back to the starting-point. Where they meet, a half turn is taken, and the rollers are then carried from opposite directions around the face (Fig. 77). On coming back to the starting-point, another half turn is taken, and the rolls again pass around



FIG. 77.—The application of the knotted bandage.

the head. Alternate head and face turns are taken until several knots are formed upon the side of the head; then secure the bandage.

**Uses.**—The knotted bandage is used to exert pressure upon the temporal vessels.

#### **BANDAGES FOR THE UPPER EXTREMITY.**

**Ascending Spica of the Shoulder.**—Use a roll two and a half to three inches wide and seven yards long.

Fix the bandage by several circular turns about the middle

of the injured arm, then carry the bandage across the chest (if the right side is injured), and across the back (if the left side is injured); continue the turn around the body, under the armpit of the uninjured side and back to the injured arm. Then pass around the arm, forming a spica with the first turn (see Fig. 70). Repeat the turns until the arm and shoulder are covered (Fig. 78). Each turn about the shoulder should overlap two-thirds of the previous turn from below upward,



FIG. 78.—Spica of the shoulder.

forming an ascending spica. As the turns approach the uninjured side, they should converge toward the armpit.

**Uses.**—For fractures and dislocations of the clavicle and to retain dressings upon the shoulder and upper part of the arm.

**Figure-of-eight Bandage of Neck and Shoulder.**—Use a roll two and a half inches wide and five yards long.

After fixing the bandage by several circular turns about the neck, carry the roll from behind up over the base of the neck,

down in front of the injured shoulder, and under the armpit. It then passes from behind, up over the summit of the shoulder, in front of the neck, and back to the point of starting. Repeat this turn, each time overlapping from below upward (Fig. 79).

**Uses.**—To retain dressings upon the neck and shoulder or in the armpit.



FIG. 79.—Figure-of-eight of neck and shoulder.

**The Velpeau Bandage.**—Two bandages, each two and a half inches wide and seven yards long, will be required.

To apply the bandage, first place the hand of the injured side upon the sound shoulder, some cotton being interposed between it and the skin. The initial end of the bandage is placed upon the shoulder blade of the uninjured side, while the roll is carried up over the injured shoulder, and down in front of the arm half way to the elbow. From this point the roll gradually passes to the outer aspect of the arm. It is then brought forward, passing in turn below the elbow, across the front of the chest, up under the armpit of the sound side, and back to the point of starting. The next turn is an exact repetition of this and overlies it. On reach-

ing the armpit the second time, the bandage continues directly across the back, taking in the elbow of the injured side. It then passes under the armpit and returns to the original starting-point over the uninjured shoulder blade. A turn is now made up over the shoulder which overlaps two-thirds of the first shoulder turn. This is followed by a body turn which overlaps one-half of the first body turn. Shoulder and body turns alternate until the shoulder turns reach and



FIG. 80.—Velpau bandage.

support the elbow and the body turns confine the wrist, the hand being left free (Fig. 80). Secure the bandage and pin all points of intersection.

**Uses.**—It is used extensively as a dressing for fractures and dislocations of the clavicle and in injuries to the humerus.

**Desault's Bandage.**—It is a complicated dressing and requires for its application three separate rollers, each about two and a half inches wide and seven yards long, a wedge-shaped pad to fit in the armpit, and a sling for the hand.

**Application of the first roller.**—A triangular pad is first placed in the armpit of the injured side with its base directed

upward. The initial end of the bandage is placed upon this pad, and the roll is carried around the chest, making four spiral turns. Several figure-of-eight turns are then made



FIG. 81.—Desault's bandage, first roller.

between the uninjured shoulder and the pad in the armpit (Fig. 81). This roll is used simply as a means of holding the pad firmly in the armpit.

The same result may be obtained by using adhesive strips which pass between the chest and the back, including the pad.

**Application of the second roller.**—It consists of numerous spiral turns passing around the chest and including the arm of the injured side (Fig. 82). Its object is to throw the point of the shoulder outward, using the arm as a lever and the pad as a fulcrum. Thus the turns are begun above, and, as they descend, each turn is applied with more tension than the previous one.



FIG. 82.—Desault's bandage, second roller.

**Application of the third roller.**—Place the initial extremity of the bandage under the armpit of the sound side and carry the roller up across the chest, over the injured shoulder, and down behind the arm of the same side until the elbow is reached. Now bring the bandage forward under the forearm and across the chest to the armpit of the sound side.

From this point the bandage passes up across the back to the injured shoulder and down in front of the arm, passing from before backward under the forearm, where it intersects the previous turn. It is then carried up across the back to the uninjured arm-pit again. Repeat these turns three times, and the bandage is complete (Fig. 83). If properly applied this roller forces the shoulder upward and backward. A sling should be applied to support the forearm and hand, and all points of intersection should be pinned.



FIG. 83.—Desault's bandage, third roller.

**Uses.**—Desault's bandage is especially useful in fracture of the clavicle. It may also be applied as a dressing for dislocations and injuries to the humerus.

**Figure-of-eight Bandage of the Elbow.**—Use a roll two and a half inches wide and two yards long.



FIG. 84.—Figure-of-eight bandage of the elbow.

Fix the bandage two or three inches below the elbow-joint by several circular turns about the forearm. Then carry the roller obliquely across the front of the joint and up the arm as high as it is intended to carry the bandage. Make a circular turn here and descend across the joint to the point of starting, intersecting the first turn. Repeat these turns, overlapping two-thirds of the

and up the arm as high as it is intended

preceding turn each time, until only the point of the elbow remains uncovered (Fig. 84). This may be covered in by a circular turn. The bandage should be secured by pinning or tying.



FIG. 85.—Spiral reversed bandage of the upper extremity.

**Uses.**—To retain dressings and afford support to the elbow.

**Spiral Reversed Bandage of the Upper Extremity.**—A roller two and a half inches wide and seven yards long will be required.

After fixing the bandage about the wrist by circular turns, carry the roll across the back of the hand and around the palm, encircling the fingers. Continue to cover in the hand, using figure-of-eight turns between it and the wrist, each turn overlapping two-thirds of the preceding one. Then ascend the forearm with spiral turns until its increasing circumference causes them to fit loosely, when spiral reversed turns should be substituted. The elbow may be covered with spiral turns or by a figure-of-eight, and the rest of the arm by spiral reversed turns (Fig. 85).

**Uses.**—To retain dressings and furnish support for the upper extremity.

**Spica of the Thumb.**—Use a roller one inch wide and three yards long.

First fix the bandage about the wrist by circular turns. After carrying the roll to the end of the thumb, make a circular turn at that point. The thumb may then be covered by a series of figure-of-eight turns which pass between it and the wrist, each turn overlapping two-thirds of the preceding turn (Fig. 86).

**Uses.**—To retain dressings and afford support for the thumb.



FIG. 86.—Spica of the thumb.

**Gauntlet Bandage, or Spiral of the Fingers.**—Use a roll one inch wide and five yards long.

Fix the bandage by circular turns around the wrist and cover in the thumb with a spica or spiral turn. Return to the wrist, make another circular turn, and cover in the next finger with a spiral turn. Each finger in turn is covered in this manner (Fig. 87).

**Uses.**—To retain dressings upon the fingers.

**The Demi-gauntlet Bandage.**—Use a roller one inch wide and three yards long.

After fixing the bandage about the wrist by circular turns, carry the roll across the back of the hand to the thumb, which is encircled by one turn. The bandage is then carried across the back of the hand to the wrist, when another circular turn is made. Continue as above with each finger, and secure



FIG. 87.—The gauntlet bandage.

the bandage by pinning or tying at the wrist (Fig. 88). The bandage must be applied loosely or it will become too tight upon closing the fingers.

**Uses.**—To retain dressings lightly upon the dorsum of the hand.

#### BANDAGES OF THE TRUNK.

**The Spiral Bandage of the Chest.**—Use a roller

three to four inches wide and seven yards long.

Fix the bandage by several circular turns about the waist. Then proceed to cover in the chest as far as the armpits with spiral turns which overlap one-half from below upward.



FIG. 88.—The demi-gauntlet bandage.



**Uses.**—As a dressing for fractured ribs and to retain dressings upon the chest.

**Posterior Figure-of-eight Bandage of the Chest.**—Use a roll two and a half inches wide and seven yards long.

Fix the bandage by several circular turns about the left arm and carry the roller up over the left shoulder, and across the back to the right armpit. From here the bandage passes up over the right shoulder, down across the back to the left



FIG. 89.—Posterior figure-of-eight of chest.

armpit, and then back to the left shoulder. Repeat this turn, each time overlapping two-thirds of the previous turn (Fig. 89). If desired, the bandage may be started upon the left shoulder without securing it to the left arm.

**Uses.**—To draw the shoulders backward and to retain dressings upon the back of the shoulders.

**Single Spica of the Breast.**—Use a roll two and a half inches wide and seven yards long.

Place the initial end of the bandage upon the shoulder

blade of the affected side and carry the roll up across the back, over the shoulder of the sound side, across the chest, and under the affected breast to the point of starting. Repeat this turn once to fix the bandage, and then make a circular turn about the chest, taking in the lower portion of the affected breast, but passing beneath the sound breast. Repeat the circular and shoulder turns, overlapping two-thirds of the previous turn each time until the breast is completely covered (Fig. 90).

**Uses.**—To retain dressings and to afford support to the breast.

**Double Spica of the Breast.**—Use a roll two and a half inches wide and ten yards long.

Start the bandage upon the right shoulder blade and carry it over the opposite shoulder and down across the chest, passing under the right breast. Continue around the back of the chest until the left breast is reached. Here the roll passes obliquely up under it, across the chest, over the right shoulder and backward to the starting-point. Now make a circular turn about the chest, taking in the lower border of both breasts. Alternate these turns, overlapping two-thirds each time until the breasts are fully covered. Secure points of intersection by pins.

**Uses.**—To retain dressings and to support the breasts.



FIG. 90.—Spica of the breast (Keen and White).

#### BANDAGES OF THE LOWER EXTREMITY.

**Ascending Spica of the Thigh.**—Use a roll three inches wide and seven yards long. To apply properly, a block of wood or a cushion to elevate the hips will be required.

Fix the initial extremity of the bandage about the thigh of the affected side by circular turns, and carry the roll from the

outer side of the thigh inward across the groin and obliquely over the pubes to above the crest of the ilium on the opposite side. Pass on around the back, down over the ilium, across the groin to the inner side of the thigh, here intersecting the first turn. Encircle the thigh and repeat the turn. Each turn ascends and overlaps the previous turn two-thirds, forming a spica of the groin. The turns should all converge as they



FIG. 91.—Spica of the thigh.

pass around the crest of the ilium (Fig. 91). Pin the points of intersection.

**Uses.**—To retain dressings upon the groin and as a means of support.

**Double Spica of the Thigh.**—Use a roller three inches wide and ten yards long.

Fix the bandage about one thigh by circular turns and carry the roll as for a single spica across the pubes and around the body. Then pass across the abdomen and obliquely down the opposite groin to the outer side of this thigh. Encircle the thigh and carry the roll up across the groin from within outward, intersecting the first turn. Then pass to the crest of the ilium, around the back, and obliquely downward across the groin to the point of starting. Repeat the turns, overlapping two-thirds ascending.

**Uses.**—To retain dressing upon both groins.

**Figure-of-eight Bandage of the Knee.**—Use a roller two and a half inches wide and two yards long.

Fix the bandage about the leg by circular turns two or three inches below the knee-joint and carry the roll obliquely upward across the back of the knee to the highest point above the knee to which it is desired to carry the bandage. Make a circular turn here and carry the bandage obliquely across the back of

the knee, intersecting the first turn. Repeat these turns, overlapping two-thirds ascending and descending, and cover the knee-cap with a circular turn.

**Uses.**—To retain dressing and furnish support for the knee-joint.

**Spica Bandage of the Foot.**—Use a roller two and a half inches wide and three yards long.

Fix the bandage about the ankle by circular turns and carry the roll obliquely across the dorsum of the foot, making a



FIG. 92.—Spica of the foot.

circular turn around the proximal end of the toes. Follow this by a turn which passes to the heel and across the back of the foot, intersecting the first turn and forming a spica over the back of the foot. Repeat the turns, overlapping two-thirds ascending and descending, until the foot is covered in (Fig. 92).

**Uses.**—To retain dressings and furnish support for the foot.

**Complete Bandage of the Foot.**—Use a roller two and a half inches wide and three yards long.

Fix the initial extremity of the bandage around the ankle by circular turns and carry the roll obliquely down across the back of the foot, making a circular turn around the toes.

Cover the foot as far as the instep with a spica or spiral reversed turns. Then pass down across the point of the heel and back



FIG. 93.—Complete bandage of the foot.

across the instep. The turn then passes down under the sole of the foot, obliquely up around the heel, and under the malle-



FIG. 94.—Spiral reversed bandage of the lower extremity.

olus of the same side to the instep again. Then pass to the sole of the foot, up under the malleolus of the other side, and

around the heel to the starting-point (Fig. 93). Finally secure the bandage by a few turns around the ankle.

**Uses.**—To retain dressings and exert uniform pressure.

**Spiral Reversed Bandage of the Lower Extremity.**—

Use a roller two and a half inches wide and fourteen yards long.

Fix the bandage about the ankle by circular turns and cover in the foot by a spica. Continue up the leg using spiral turns until the circumference of the part begins to perceptibly increase, then substitute spiral reversed turns. Cover in the knee by spiral turns or by a figure-of-eight and continue up the thigh, using spiral reverses (Fig. 94).

**Uses.**—To retain dressings and for support.

**THE HANDKERCHIEF BANDAGE.**

The handkerchief, or triangular, bandage is most useful in emergencies, as it may readily be made from a large handkerchief or piece of cloth, and its application is not a matter of great difficulty. It may be used in dressing wounds, for supporting fractures, as a means of controlling hemorrhage, and for slings. In fact it can be put to all the uses of the roller bandage, and on account of the small space it occupies when folded—being easily placed in the pocket—it makes an excellent dressing to carry upon the field.

**Manner of Making the Bandage.**—A piece of muslin or linen about a yard square is cut diagonally from opposite corners into two triangles, or the square may be folded once upon itself, thus forming a triangle (Fig. 95).

**To Fold the Bandage.**—When not in use or for the purpose of making a convenient package for transportation, the bandage may be folded as follows: Spread the material out on a flat surface and fold it through the center, bringing the end *C* over to the end *B*, as shown in Fig. 95. Next bring the apex *A* over to the end *D* and the ends *B C* to the end *D* (Fig. 96).

A square is thus formed, which is folded in half, bringing side *Y* to side *X* (Fig. 97).

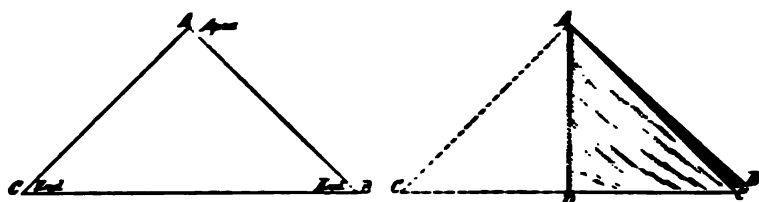


FIG. 95.

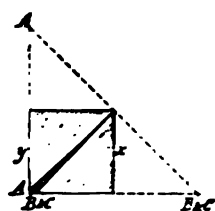


FIG. 96.

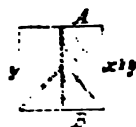


FIG. 97.



FIG. 98.



FIG. 99.

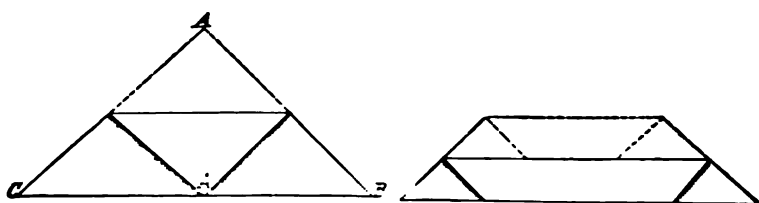


FIG. 100.

FIGS. 95-100.—Method of folding the handkerchief bandage.

We now have a quadrilateral. Fold its two sides *A* and *B* over, making them meet in the center *C* (Fig. 98).

Finally, to make more compact, bring the side *X* over to the side *Y* (Fig. 99).

A handkerchief bandage may be used in the form of a triangle, as a cravat, or as a cord.

To fold a cravat, bring apex *A* to the base. Repeat this, folding the bandage lengthwise upon itself several times (Fig. 100).

To form a cord, continue folding till a narrow strip is formed.



FIG. 101.—Application of the square cap.



FIG. 102.—The square cap completed.

#### FORMS OF HANDKERCHIEF BANDAGES.

**The Square Cap.**—Take an ordinary piece of muslin a yard square and fold it into a quadrilateral with the upper portion three inches shorter than the lower. This is then laid over the head with the shorter portion uppermost; the longer portion should overhang the face, while the shorter portion just covers the forehead (Fig. 101). The two ends of this shorter portion are now tied under the chin. The flap of the longer portion is turned back exposing the eyes. Its ends



are carried behind the head and tied, sufficient tension being employed to make the bandage fit the head snugly (Fig. 102).

**Uses.**—To protect the head and retain dressings upon the scalp.

**Triangular Bandage of the Head.**—The base of the triangle is placed upon the forehead, and its apex is carried to the back of the head. The two ends of the triangle are carried around the head and are tied over the forehead. The bandage



FIG. 103.—Triangular bandage of the head.

is tightened by pulling upon the apex, which is then turned forward and fastened to the body of the bandage (Fig. 103).

**Uses.**—To exert pressure and retain dressings upon the head.

**Cravat Bandage of the Jaw.**—Fold the triangle into a cravat as already described (page 137). The body of the cravat is applied beneath the chin. The two ends are carried up over the head, crossing each other upon the top of the skull. They then pass downward,

and are made secure beneath the chin (Fig. 104).

**Uses.**—For fractures of the jaw and wounds of the chin.

**Cravat Bandage of the Eye.**—Form a cravat and place its center over the injured eye. Carry the two ends obliquely around the head, one passing up over the forehead, and the other passing down over the ear. They cross behind the head, and, passing forward, are tied in front (Fig. 106).

**Uses.**—To retain compresses upon the eye.

**Cravat Bandage of the Shoulder.**—Fold a cravat and place its body in the armpit of the affected side. The ends pass up over the shoulder and cross each other, one passing around



FIG. 104.—Cravat bandage of the jaw.  
FIG. 105.—Triangular bandage of the chest.



FIG. 106.—Cravat bandage of the eye.

behind the neck and the other in front of the neck. They are secured under the opposite armpit (Fig. 107).



FIG. 107.—Cravat bandage of the shoulder.

**Uses.**—To retain dressings in the armpit or upon the shoulder.

**Triangular Bandage of the Shoulder.**—Place the base of the triangle around the arm with its apex up over the shoulder. Carry the two ends around the arm, securing them on the outer side.

A sling supporting the injured arm is then applied as shown in the accompanying illustration (Fig. 108), and the apex of the bandage is folded back over the sling and secured to the body of the bandage.

**Uses.**—For injuries of the shoulder.

**Triangular Bandage of the Elbow.**—

Flex the forearm, fold a large hem in the base of the triangle, and place its center over the front of the elbow, the apex of the triangle being up. Carry the two ends of the triangle around the forearm once. After crossing in front of the joint, they pass



FIG. 108.—Triangular bandage of the shoulder.

FIG. 109.—Triangular bandage of the hand.

up and around the arm, taking in the apex of the triangle. Secure the two ends, bring down the apex, and fasten it to the body of the triangle.

**Uses.**—To retain dressings upon the elbow.

**Triangular Bandage of the Hand.**—Place the base of the triangle, with the apex down, upon the palmar or dorsal surface of the wrist, according to which surface is injured. Fold back the apex over the fingers to the wrist and secure it in place by tying the two ends around the wrist. The apex is then folded back and fastened to the body of the bandage (Fig. 109).

**Uses.**—To retain dressings upon the hand.

**Cravat Bandage of the Hand.**—Place the body of the cravat upon the palm of the hand and carry the two ends around the hand, crossing over the dorsum. The two ends then pass to the wrist, which they encircle, and are finally tied upon the dorsal surface.

**Uses.**—To exert pressure upon the dorsal surface of the hand.

**Triangular Bandage of the Breast.**—Place the base of the triangle under the affected breast with its apex extending over the shoulder of the same side. One end of the triangle is carried up over the opposite shoulder, and the other is carried down under the armpit. The two ends and the apex are then tied behind.

**Uses.**—To support the breast.

**Triangular Bandage of the Chest.**—The base of the triangle is placed

across the chest, and its apex is carried up over the shoulder of the affected side. The two ends of the triangle pass around the body, below the armpits, and are tied, the apex being fastened to them by a pin (Fig. 105).



FIG. 110.—Triangular bandage of the breast.

**Uses.**—To retain dressings in injuries of the chest, or as a dressing for fracture of the ribs.



FIG. 111.—Triangular bandage of the thigh.

**Triangular Bandage of the Thigh.**—To apply properly, a cravat is also necessary. Fasten the cravat around the waist. Then place the base of the triangle with its apex upward around the injured thigh, and, after carrying the two ends around the thigh, secure them in front. The apex of the triangle is slipped under the cravat and is secured to the body of the bandage by pins (Fig. 111).

**Uses.**—To retain dressings upon the groin and upon the upper part of the thigh.

**Cravat Bandage of the Knee.**—Placing the body of the cravat above the knee-cap, carry its two ends around the limb, crossing behind; then carry them downward below the knee and tie around the leg (Fig. 112).



FIG. 112.—Cravat bandage of the knee.

**Uses.**—To hold fragments of a broken knee-cap in apposition.

**Triangular Bandage of the Foot.**—Place the base of the

triangle behind the ankle. The apex is carried forward under the sole of the foot, and up over the toes to the front of the ankle. The two ends pass forward around the ankle, including the apex. After crossing each other, they encircle the foot and are tied upon the dorsal surface. The apex is then folded back and pinned to the body of the bandage (Fig. 113).

**Uses.**—To retain dressings upon the foot.

**Triangular Bandage for the Stump of a Limb.**—Place the base of the triangle above and behind the stump. Bring the apex up over the end of the stump and encircle it with the two ends, which are then tied. The apex is folded back and fastened to the body of the triangle.

**Uses.**—To retain dressings upon the stump of a limb.



FIG. 113.—Triangular bandage of the foot.

#### OTHER FORMS OF BANDAGES.

**The T-Bandage** consists of two strips of muslin or flannel, —a horizontal piece, sufficiently long to pass once or twice about the part to which it is to be applied, and a vertical piece, half as long as the horizontal strip, to the center of which it is attached. This bandage may be applied to the head or perineum for purposes of retaining dressings.

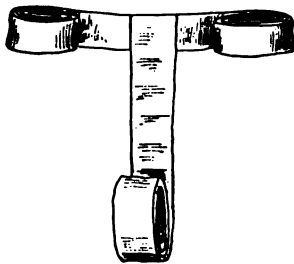


FIG. 114.—T-bandage (Stoney).

As a dressing for the head, the horizontal piece is carried around the cranium, while the vertical strip crosses the top of the head and passes beneath the first piece on the opposite side, to which it is fastened.

**Four-tailed Bandages** are made by splitting each of the two extremities of a broad strip of muslin into two tails to within a short distance of the center. Such bandages are used for fractures of the lower jaw, as a temporary dressing for

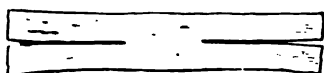


FIG. 115.—Four-tailed bandage (Stoney.)

fractures of the clavicle, and to retain dressings upon the head.

In applying this bandage to the jaw, the two ends of a piece of muslin four inches wide and one and a half yards long are torn into two tails to within five inches of each other. The central portion of the bandage is placed over the chin, the two lower tails are carried up over the head and are there tied, while the two upper tails are carried behind the neck and tied (Fig. 116).



FIG. 116.—Four-tailed bandage of the jaw.

**The Many-tailed Bandage, or Bandage of Scultetus,** may be made by splitting the extremities of a narrow piece of muslin, or, if a broad piece is required, its sides into a number of tails to within a few inches of its center. The width and length of the bandage will vary according to the size of the part to which it is to be applied.

The bandage is applied as follows: The body of the bandage is placed beneath the part, and, then, either the two uppermost or the two lowest tails are brought forward from opposite sides, crossing each other over the front of the part, from which point they are continued down to the sides. The next pair of tails are applied in the same manner overlapping the previous pair one-third, and so on, until all are



FIG. 117.—Many-tailed bandage for the abdomen. The appearance of the bandage before application is shown in the upper right-hand corner of the illustration (Fowler).

applied. The last tails will have to be secured by pins, and, if it should be deemed necessary, each of the tails may be pinned at the sides for added security. (Fig. 117).

The many-tailed bandage is a most useful appliance for holding dressings in place upon the abdomen, or for furnishing support to that region, it being also used as a dressing for injuries of the extremities. When used for the latter purpose, the bandage is modified as shown in Fig. 118.

The bandage may also be made by simply cutting an ordinary roller bandage into a sufficient number of pieces to cover the part, each piece being long enough to encircle the part and overlap for a distance of two or three inches. The centers of the various pieces are applied beneath the part in such a way



that they slightly overlap each other, the tails being made secure by pins in the manner described above. If applied in this way

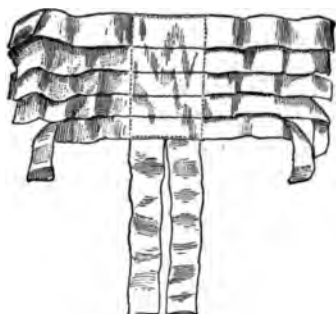


FIG. 118.—Modified Scultetus bandage (Stoney).

new strips can be inserted at any time in place of those that may become soiled without disturbing the limb.

**Borsch's Eye Bandage** is applied as follows: First carry a circular turn of a roller bandage around the head, covering in both eyes. To this a narrow piece of bandage is fastened behind and is carried up over the head to the sound eye. It then passes beneath the first turn and is folded back, just sufficient traction being made to raise the bandage from the uninjured eye. The end can be then secured by pins (Fig. 119).

### SLINGS.

Slings are employed as a means of support for the extremities following an injury. They may be made from an ordinary bandage, a cravat, or a triangular bandage.

**Ordinary Sling.**—A roller bandage or cravat about four inches wide is obtained. A loop supporting the injured arm is formed, and the two ends are tied behind the neck.

**Triangular Sling.**—Place the base of the triangle under the wrist of the affected arm, with the apex extending out behind the elbow. The end nearest the body is carried up over the opposite shoulder, while



FIG. 119.—Borsch's eye-bandage (Da Costa).

the other end is carried up over the shoulder of the injured side. The two ends are tied behind the neck, while the apex



Fig. 120.—Triangular sling.



FIG. 121.—Triangular sling.

is folded forward from behind the elbow and fastened to the body of the bandage in front (Fig. 120).

**Triangular Sling (where the Shoulder of the same side is Injured).**—In this case the sling must be arranged so as not to press upon the injured shoulder. Arrange the triangle as before, and carry the end nearest the body up over the opposite shoulder. The other end is carried beneath the arm of the injured side and up behind the shoulder of the other side, where the two ends meet and are tied. The apex of the bandage is pinned to the body of the sling (Fig. 121).



FIG. 122.—Triangular sling.

**Triangular Sling (where the opposite Shoulder is Injured).**—Arrange the triangle as before, but carry the end nearest the body up in front of and over the shoulder of the injured side. The other end passes beneath the arm and up behind the shoulder, where it is tied to the first end. The apex is then pinned to the body of the triangle (Fig. 122).

An arm-sling may also be improvised by utilizing the coat-sleeve as a means of support. The injured arm is placed across the chest with the hand beneath the opposite side of the coat between two buttons. The sleeve is then made secure to the coat by pinning at the wrist and elbow-joint.

## CHAPTER X.

### DRESSINGS.

The most desirable form of dressing for wounds consists of dry sterilized gauze or antiseptic gauze. The gauze can usually be obtained in air-tight packages, sterilized and ready for use. Should it not be available, ordinary lint, flannel, muslin, or even a clean handkerchief or a clean rag, may be used; but they should, if possible, be rendered sterile before using by boiling for five minutes. In emergencies, however, dressings may be rendered antiseptic by soaking them in a 1 to 2000 solution of bichloride of mercury (one  $7\frac{1}{2}$ -grain tablet of bichloride of mercury dissolved in a quart of warm water), in a 1 to 100 solution of carbolic acid ( $1\frac{1}{4}$  teaspoonfuls of carbolic acid to a pint of warm water), or in a saturated solution of boric acid (5 teaspoonfuls of boric acid dissolved in a pint of warm water). Gauze or muslin soaked in alcohol, salt and water, or vinegar, may be employed when nothing better is at hand.

An excellent dressing for small, clean cuts consists of flexible collodion. This is a liquid preparation which can be applied over a wounded surface with a small brush, and, upon exposure to the air, it hardens, forming a thin skin or protective. A thin layer of cotton saturated with collodion forms a more substantial dressing than the collodion alone.

### ADHESIVE PLASTERS.

Adhesive plaster is used extensively in surgery for the purpose of holding dressings and splints in position, as a method of approximating the edges of wounds, and for the fixation of fractures, sprains, and strains.

For these purposes ordinary rubber adhesive, or what is

known as moleskin, or resin plaster, may be used. The plaster is cut into strips of the required width and length and, in the case of the resin plaster, requires to be heated by passing through a flame before application; rubber adhesive will adhere to the skin without heating, but has the disadvantage of producing an irritation of the skin when applied for any length of time. There is a rubber adhesive, known as "Z. O." plaster, which has all the adhesive properties of ordinary rubber plaster without producing this irritation, and for this reason is far preferable to the former. If the plaster is to be applied to a part on which there is any hair, the skin should be first shaved, otherwise the removal of the plaster will be very uncomfortable for the patient.

**Strapping Dressings and Splints.**—For this purpose strips of plaster one to two inches wide are used.

To secure a dressing to a part a number of these strips should be applied at intervals of one to two inches, and each

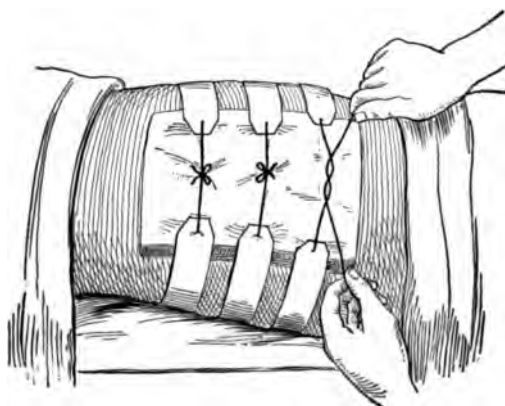


FIG. 123.—Fixation of dressing when frequent change is necessary (Keen's Surgery).

strip should be long enough to reach an inch or two beyond the dressing without entirely encircling the part. Before applying, the tips of the strips should be so folded that the adhesive surfaces are in apposition, thus preventing the extreme ends of the

plaster from adhering to the skin. If this is done it will be found that the removal of the strips will be facilitated.

Another method of holding dressings in place is by the use of adhesive plaster combined with strings or tapes. Short strips of plaster are fastened to the skin at intervals near the outer edges of the dressing, to the free ends of which are attached tapes or strings, fastened through holes in the plaster. These tapes are tied over the dressing, as much tension being employed as is wished (Fig. 123). This method has this advantage,—that the dressings may be removed without disturbing the plasters by simply untying the tapes; it is very useful where dressings have to be frequently changed.

Strapping splints in place with adhesive is an excellent method to prevent them from slipping. The strips should be applied around the splints in at least three places,—top, middle, and bottom. A bandage may be applied over this, if so desired.

**Strapping Wounds.**—In the treatment of wounds adhesive straps are often employed in the place of sutures, and, if carefully applied, as accurate an approximation of the divided edges can be obtained as from sutures. They also have an advantage over sutures in that scars resulting from the insertion of the stitches are avoided.

Narrow strips should be applied at frequent intervals across the edges of the wound, but should never entirely encircle a limb. The ends of the strips are fastened to one side of the wound, and, while the edges of the wound are held in apposition, the other ends are carried across the wound and applied to the skin beyond.

Another method is by the application of two strips. A longitudinal slit is cut in the center of one strip, and the sides of the other strip are cut away at its center so that it will fit into the slit in the first strip. The second strip is then threaded through the slit in the first, and one end of each strip is fastened on opposite sides of the wound, the free ends being drawn on sufficiently to bring the edges of the wound in apposition, and they are then fastened (Fig. 124).

In removing adhesive straps always loosen both ends from the skin and pull them off *toward the wound*, thus avoiding any danger of reopening the wound.



FIG. 124.—The application of adhesive straps to a wound.

**Strapping Fractures.**—This method is used in immobilizing fractures of the ribs, sternum, and clavicle.

For fractures of the ribs, strips of plaster about two inches wide and long enough to reach from the spine to a little beyond the median line of the

sternum are used. One end of the strip is fastened to the skin over the spine behind and is brought forward, with some tension, around the chest to the median line in front. Each strip is applied in succession in the same manner from below upward, overlapping about one-third until the side of the chest is covered. If desired, a single broad strip of plaster may be applied instead of separate strips (page 231).



FIG. 125.—Strapping the ribs.

For fractures of the sternum, the strips are applied to the

front of the chest for some distance above and below the fracture, each strip extending from the middle of the side of the chest on one side to a corresponding point on the opposite side.

A method of treating fractures of the clavicle by adhesive straps, known as Sayre's method, consists in the application of two strips of plaster, each about three inches wide. An end of one strip is passed



FIG. 126.—Sayre dressing for broken collar-bone. Application of first plaster.



FIG. 127.—Sayre dressing for broken collar-bone, completed.

around the center of the arm of the injured side in the form of a large loop, with the nonadhesive side toward the skin, the end

of this loop being secured by pins or stitches. The other end is carried from behind forward, completely around the chest, pulling the arm somewhat backward, and is secured to itself behind (Fig. 126). The second strip starts over the sound shoulder, passes obliquely down the back, covering the point of the elbow, and then upward taking in the forearm, which has been previously flexed, to the starting-point on the sound shoulder, where the two ends are secured (Fig. 127).

where the two ends are secured (Fig. 127).



The second strip should be applied in such a way to the elbow that it forces it forward and throws the shoulder back. The portion of the plaster under the elbow should be slit for an inch or two to receive the point of the elbow.

**Strapping Joints** is a useful method of treating sprains, serving to exert pressure upon the joint and support the injured ligaments. It is applicable especially to the ankle, knee, wrist, and elbow-joints.

For the ankle-joint strips of adhesive plaster one inch wide and about eighteen inches long are employed. A strip is



FIG. 128.—Strapping an ankle-joint.

started well behind at the junction of the lower and middle third of the leg on the uninjured side, and is carried down under the heel with considerable tension, across the sole, and up the other side of the joint. The middle of another strip is applied to the point of the heel, and the two ends are carried forward over the foot, but not far enough to meet. Leg strips and foot strips alternate, interlacing with each other and overlapping about one-third of the previous strip each time until the ankle-joint is covered (Fig. 128).

To strap the knee-joint, three strips of plaster, each one and a half inches wide and about eight or nine inches long, will be

required. The first strip is applied above the knee-cap; the second below the knee-cap; and the third one passes directly over the knee-cap (Fig. 129), slightly overlapping the edges of the first and second strips. Each strip should be applied snugly and the strips should be of such length that they do *not* entirely encircle the joint.



FIG. 129.—Strapping applied to knee (Crandon).

#### **"FIRST AID" OUTFIT.**

For the benefit of those who, being in a locality where accidents are of frequent occurrence or where medical supplies are not easily obtained, wish to properly equip themselves for the treatment of ordinary emergency cases, a list of a few necessary articles is given.

Such an outfit should contain half a dozen bandages varying from one to four inches in width; a spool of adhesive plaster, two inches wide; a tourniquet; a roll of absorbent cotton; a package of sterile gauze; a package of antiseptic (bichloride) gauze; half a dozen tubes of sterilized catgut and silk; three or four surgeon's needles of medium size; a pair of scissors; a hand brush; a small basin; a bottle of liquid soap; a bottle of bichloride of mercury tablets; a small bottle of carbolic acid; and a small flask for whiskey. The above outfit, obtainable from almost any druggist at little expense, can be readily

packed away in a small box and should be sufficient for all practical purposes. To this may be added a pocket case containing one or two knives, scissors, artery clamps, etc.

In the Army each soldier is provided with a small first aid



FIG. 130.—“First aid” outfit.

or field dressing outfit consisting of two antiseptic compresses, an antiseptic bandage, a handkerchief bandage, and safety pins. All are contained in a small waterproof package, upon the outside of which are directions as to the manner of applying, etc.

## CHAPTER XI.

### MEDICATION AND PRACTICAL REMEDIES.

#### MEDICATION.

The administration of drugs, outside of those agents employed as stimulants, is not often required in emergencies, yet a knowledge of this subject may at times prove of the greatest possible value in the absence of a physician or nurse. A little space will, therefore, be devoted to the subject.

Medication by mouth is the method most frequently employed, and is applicable to those cases where a very rapid effect from the drug is not of prime importance, for it takes from 20 to 30 minutes for a drug to be absorbed from the stomach and its effects to be felt. In cases where a very rapid action is desired, drugs are injected by means of a hypodermic syringe into the tissues beneath the skin—from which absorption takes place within 4 or 5 minutes—but this is a method that should only be employed by a physician or nurse and will not be described here. A third method of administering drugs and stimulants is by the rectum.

**Medication by Mouth.**—When administered by mouth, drugs are prescribed in the form of solutions, pills, or powders. It should be remembered that a drug is absorbed more rapidly when given *in solution* and *upon an empty stomach*, while pills and powders are absorbed with comparative slowness, as they have first to be dissolved in the fluids of the stomach before absorption is possible. Likewise, in giving stimulants, a more profound effect is obtained if they are administered hot, as heat in itself is somewhat of a stimulant.

The quantity of a drug administered at a given time will, of course, vary according to the particular drug used and the

purpose for which it is prescribed, drops, teaspoonfuls, dessert-spoonfuls, and tablespoonfuls being the doses employed. Roughly, one drop equals a minim; a teaspoonful equals a dram; a dessertspoonful equals two drams; and a tablespoonful equals half an ounce. When minims, drams, etc., are prescribed and if great accuracy in dosage is required, as with the more powerful remedies, the doses should be measured



FIG. 131.—Medicine-dropper  
(Stoney).



FIG. 132.—Medicine-glass  
(Stoney).

and in the second instance in a medicine glass (Fig. 132). The glass or dropper used for this purpose should always be perfectly clean, being carefully washed out both before and after use. *Before any drug is administered, one should be absolutely sure it is the correct one*—to make doubly sure, the label should be carefully read before the drug is measured out and again before giving it to the patient.

**Rectal Medication.**—When the stomach is unable to retain anything or if the patient is in such a condition that he cannot take medicines by the mouth, they may be introduced into the rectum by means of an enema or in a suppository. It should be remembered, however, in giving drugs in this way that, while the absorptive power of the bowel is great, drugs are taken into the circulation slowly—in about three-quarters of an hour—and, if a rapid effect is desired, this method should not be employed. As a rule, unless the drug is very powerful, the dose is twice the quantity given by the mouth.

The method of giving an enema will be found described on page 166.

A suppository consists of a small cone-shaped mass of cocoa-butter in which the desired drug is incorporated. The

suppository is pushed several inches into the bowel where it rapidly melts, permitting the drug to be absorbed.

#### COLD AS A REMEDY.

Cold applied over the entire surface of the body is a means of reducing the bodily temperature in fevers. Cold acts locally by producing a contraction of the blood-vessels in the area to which it is applied. By thus lessening the amount of blood in a part it is especially useful not only in limiting congestion in the early stages of an inflammation, but also in relieving pain to a great extent by taking the pressure of the blood from the terminal nerves.

As a means of reducing high bodily temperature cold is usually employed in the form of a cold sponge or cold tub. Either method to be efficacious must be accompanied by a thorough rubbing of the surface of the body during the bath. This friction is very necessary in order to bring the overheated blood to the surface of the body, from which the heat may be abstracted. The action of cold is only a temporary one, and in long-continued fevers it is often necessary to give baths every three or four hours to control the temperature. The bath should not be given sooner than two hours after eating; furthermore, a patient should never be left alone in a bath, as he may faint or become unconscious and drown.

**The Cold Sponge.**—In giving a cold sponge, there will be required one or two large sponges, several pails of cold water, and a bath thermometer (Fig. 133). The temperature of the water should be from 75° to 40°, according to the age and condition of the patient. For old people tepid water only should be used, as they react very poorly. The bed is covered by a rubber sheet, and the patient lies upon this, having been previously stripped. An ice-cap or clothes wrung out in ice



FIG. 133.  
—Bath-ther-  
mometer  
(Stoney).

water should be applied to the head, to lessen cerebral congestion. The body is then sponged off, beginning at the head and taking one limb at a time, only enough water being used to just dampen the surface. In this way evaporation occurs quickly, and more heat is abstracted. While the sponging is going on, constant friction of the body with the hands must be kept up. Usually sponging for ten or fifteen minutes will be sufficient to reduce the temperature several degrees. It is not safe to reduce the temperature too rapidly, as a collapse might result. The patient is finally put to bed and lightly covered with a sheet or thin blanket. Should he complain of being cold after the bath, some brandy or whiskey may be given.

**The Cold Tub.**—A portable tub, while not absolutely necessary, will be found of great assistance in giving this form of bath. The tub is about half filled with water, at a temperature of about 68° F., and the patient is immersed in this for from ten to twenty minutes. Constant friction with the hands must be kept up over the entire surface of the body during the



FIG. 134.—Ice-bag (Ashton).

time the patient is in the water, and, to prevent cerebral congestion, ice or an ice-cap should be applied to the head. As a rule a patient will shiver and complain of being cold while in the bath, but this is not a sign of any danger; should he, however, remain cold afterward, a stimulant may be given and bottles of hot water applied to the feet. If the patient is weak a stimulant, such as whiskey or brandy, may be given both before and after the bath.

**The Local Application of Cold.**—Cold may be applied locally to a part by means of cloths wrung out in ice-water and frequently changed or by the use of ice. The ice is first cracked very fine and is then placed in an ice-bag (Fig. 134), filling it half full. Before the top is screwed on it should be seen that all the air is expelled from the bag. If an ice-bag is not available, any waterproof bag will answer the purpose equally well. The ice-bag is especially useful in injuries about the head, inflammation of the brain, and in sunstroke.

#### HEAT AS A REMEDY.

Heat applied generally to the body, as, for example, by means of a hot bath produces a dilatation of the superficial blood-vessels, thus drawing blood from the brain and internal organs. The prolonged application of heat causes free perspiration with the elimination of poisonous materials from the blood. Upon the nervous and circulatory systems moderate heat has a sedative action.

Locally heat causes a dilatation of the superficial blood-vessels as well as, to a lesser extent, the deeper ones, though it is true a very high degree of heat will cause a contraction of the blood-vessels as does cold. It is generally applied locally for the purpose of relieving pain through its sedative action, to increase the inflammatory reaction, and to hasten pus formation when it is threatened.

**Hot Fomentations**, a method of applying heat locally, may be carried out as follows: A compress of flannel or lint is wrung out in boiling water and, while still hot, is applied to the affected region, being changed as soon as it becomes cool. In order to avoid burning the hands, the compress should be quickly lifted from the boiling water and transferred to a towel, when it can be wrung out by twisting the towel upon itself, as shown in the accompanying illustration (Fig. 135). It is then shaken out in the air and applied to the part. It is always well to cover the compress with oiled silk to prevent a too rapid cooling and evaporation. When changing the compresses, a



fresh one should always be in readiness before the cold one is removed.

**Dry Heat.**—This form of heat is most useful when applied to the extremities in the treatment of shock or collapse. Likewise, as a heart stimulant there is nothing better than heat applied over the region of the heart. For these purposes hot-water bags, hot bottles, heated bricks, heated salt, bran, or sand placed in a bag, may be used.

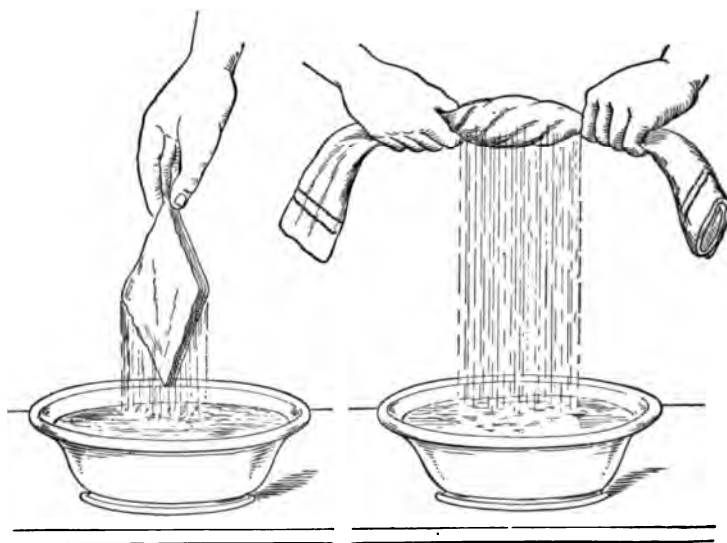


FIG. 135.—Method of wringing out a hot compress without scalding the hands (W. Easterly Ashton).

*Great care must be taken in the application of heat to the body of an unconscious person not to produce a burn.* It should be remembered that a person in such a condition is unable to offer any complaint, even though he be burned, and it is not an uncommon experience to find that the tissues of such a person are less able to withstand heat than ordinarily. It should, therefore, be an invariable rule to test the temperature of the hot-water bottles, hot-water bag, or whatever is used on one's face before applying to the skin of the patient. Furthermore,

this form of heat should never be applied directly to the skin without interposing flannel or some other material.

**The Hot Bath.**—The hot bath is given to produce perspiration and to bring about reaction in shock or collapse. It may be given in the following manner: The tub is partially filled with water at a temperature of about 100° F., and the patient is immersed in it, gradually raising the temperature of the bath up to 110° or 115° F. by adding hot water. At the end of about 10 minutes the patient is placed in bed and is carefully wrapped in blankets; cold cloths should be applied to the head and, when it is desired to induce a free perspiration, the patient should drink a glass of cold water.

**The Hot Mustard Bath.**—This form of bath acts as a powerful stimulant and is thus useful in shock or collapse. It is given in the same way as the hot bath except, instead of plain water being used, one or two tablespoonfuls of mustard are added to each gallon of water. The patient should not remain in such a bath very long,—certainly not more than ten minutes.

**The Hot-Pack.**—The hot-pack is employed to increase the activity of the skin and to produce sweating. It is frequently used in diseases of the kidneys as a means of ridding the system, through the skin, of poisonous materials which are normally excreted through the kidneys.

A hot-pack may be given as follows: The bed is first covered by a rubber sheet and a heavy dry blanket. On top of this is placed a large blanket wrung out in hot water, *i. e.*, at a temperature of from 105° to 110° F. The patient, being stripped, is laid upon the bed thus prepared and is carefully wrapped in the hot blanket (Fig. 136). Hot-water bags are then placed about his body, and he is snugly covered with the dry blanket and rubber sheet, leaving the head alone exposed. Ice or an ice-cap should be placed upon the head to prevent cerebral congestion. Should sweating fail to appear, he may be given a glass of cold water to drink; this will usually result in producing a profuse perspiration. The patient is left in the pack

about an hour. The temperature of the patient should be frequently taken and, if it begins to rise and no sweating appears, the pack should be discontinued.



FIG. 136.—Application of the hot-pack (pressing the sheet between the patient's arm and body) (Stoney).

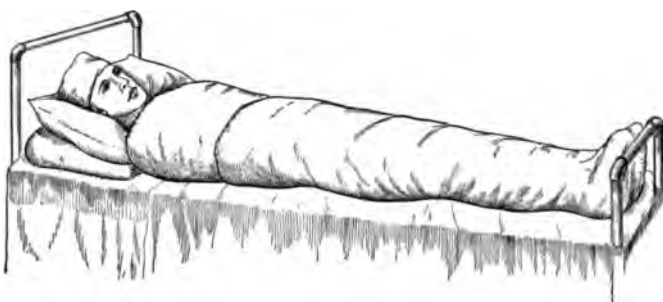


FIG. 137.—Application of the hot-pack (patient completely covered, with wet towel on the head) (Stoney).

#### POULTICES.

Poultices are used in deep-seated inflammations to produce softening of an inflammatory exudate or as an aid in separating sloughing or dead tissues from the healthy tissue.

**Flaxseed Poultice.**—To a vessel of boiling water, slowly stirred, is added ground flaxseed until the resulting mixture is about the consistency of mush. This is then evenly spread

about one-quarter of an inch or more in thickness upon a clean piece of linen or muslin, the margins of which are doubled back to prevent the flaxseed escaping. After the poultice has been applied to the skin, it should be covered with cotton or oil silk to keep it from cooling too rapidly; it will remain hot for from thirty minutes to an hour depending upon the size. A poultice once used should not be reheated and applied—instead, it should be made fresh each time.

**Charcoal Poultice.**—Charcoal poultices are useful applications for foul, sloughing wounds accompanied by an offensive discharge. They may be prepared by adding equal parts of flaxseed meal and animal charcoal to boiling water. The resulting mixture is spread evenly on a cloth and applied in the same manner as a flaxseed poultice.

#### COUNTERIRRITANTS.

They act by causing a dilatation of the vessels of the skin and reflexly by contracting the deeper vessels. The mustard poultice or mustard plaster and the turpentine stupe are the most commonly used. They are employed to relieve deep-seated pain and inflammation.

**Mustard Poultice.**—Take two and a half parts of flaxseed meal, and stir into ten parts of boiling water; to this add two and a half parts of powdered mustard, and stir well. The resulting mixture may be spread between two pieces of muslin and applied to the skin. In order to prevent blistering in children or old people, it will be necessary to add more flaxseed and thus dilute the strength of the plaster.

**Mustard Plaster.**—A mustard plaster may also be made by taking equal parts of mustard and ordinary flour, to which is added sufficient water to form a paste. This is spread between two pieces of muslin, a piece of stiff paper being placed behind the plaster to give it added firmness.

**Turpentine Stupe.**—Stir one tablespoonful of turpentine into a pint of boiling water. A piece of flannel is next dipped in the hot water and turpentine and is wrung out by twisting

in a towel, as shown in Fig. 135, and applied to the part while hot, first, however, covering the skin with olive oil. The stupe is left in place until it produces a redness of the skin, but not long enough to cause blistering. *Never attempt to warm the turpentine over a fire.*

#### ENEMATA.

Enemata, or injections of fluids into the bowels, are of several kinds and have a variety of uses. Those given to produce an evacuation by the bowels are known as purgative enemata. Another class, spoken of as nutritive enemata, are employed to administer food or drugs by the rectum. Again, in the treatment of shock or hemorrhage, large quantities



FIG. 138.—Method of giving an enema (Macfarlane).

of salt solution are frequently injected into the bowels, and these are known as saline enemata.

The simplest apparatus for administering an enema consists of an ordinary fountain syringe and hard rubber tip—found in nearly all households—or a rectal tube connected with a glass funnel and piece of rubber tubing (see Fig. 138).

To give the enema, a sheet, folded several times, or a single piece of rubber sheeting should be placed under the patient as a protection for the bed. The patient is then turned upon the left side with the knees drawn up. Having

filled the reservoir with the solution to be injected and having expelled any air from the tubing by allowing some of the solution to escape, the nozzle or rectal tube is well lubricated with olive oil or vaseline and is gently inserted into the rectum a distance of about six inches while the patient strains slightly. The reservoir is then raised two or three feet above the patient and its contents are allowed to enter the bowel (Fig. 138). The patient is apt to complain of fulness in the rectum as the fluid distends it, but, by temporarily stopping the flow, this feeling soon passes off. When the desired quantity has been introduced, the flow is shut off by pinching the tube, which is then withdrawn.

When the enema is given for the purpose of producing an evacuation of the bowels, the patient should, if possible, hold the enema for five or ten minutes before using the bed-pan. In the case of enemata to be retained, as, for example, the nutrient or saline enema, the patient should lie quietly upon the back for about half an hour and should avoid making any straining efforts.

**Purgative Enemata.**—A mild purgative enema consists of two pints of warm water well mixed with castile soap until the resulting mixture begins to thicken; such an enema is known as a simple enema. A stronger action can be obtained by adding half an ounce of Epsom salts, half an ounce of turpentine, an ounce of glycerin, or an ounce of castor oil to the above simple enema. Another good enema consists of equal parts of milk and molasses.

**Nutritive Enemata.**—In some cases where it is impossible to give food or drugs by the stomach, the fact that fluids are readily absorbed by the rectum is taken advantage of, and the nutritive enema is employed. As a temporary measure or as an adjunct to natural feeding it is most useful, but for permanent feeding it is quite impracticable. If it alone is depended upon for nourishment, life can rarely be prolonged for more than four to six weeks, though it is true that certain exceptional cases have been reported where patients lived

exclusively upon rectal feeding for longer periods. The main difficulty to prolonged feeding by rectum is that the bowel soon becomes irritated and fails to retain the fluids introduced.

In giving nutrient enemata there are certain necessary precautions to keep in mind: The enema should always be given warm—that is, at about the temperature of the body—and the amount introduced should be small (three to six ounces), as it is then more liable to be retained. Avoid giving any irritating substances and give only such food as is easily absorbed, otherwise the food acts as a foreign body and proves irritating to the bowel. The food should always be fluid in character. As a general thing starches and fats are to be avoided. As an aid to absorption, it is necessary to clean out the bowels a short time before the nutritive enema is given by means of an enema, consisting of a teaspoonful of salt to a pint of warm water. Nutritive enemata may be given every three or four hours.

A good nutritive enema consists of the whites of two eggs, half an ounce of beef tea, and four ounces of warm water.

Another good combination is made of one raw egg, half an ounce of whiskey, a pinch of salt, and three ounces of milk.

**Saline Enemata** are often used as a means of restoring the volume of fluid to the circulation after a great loss of blood from hemorrhage. The injection of salt solution into the rectum is also an excellent form of treatment for shock or collapse. On account of the readiness with which a saline enema may be given and the simplicity of the apparatus required, it is very valuable as an emergency measure.

The solution is prepared by adding a teaspoonful of salt to a pint of boiled water. A pint or a quart of this solution, heated to  $110^{\circ}$ , is the amount usually given. If a stimulating effect is desired, add from half an ounce to an ounce of whiskey to the enema, or give half a pint of black coffee (strained).

## CHAPTER XII.

### ANTISEPSIS AND DISINFECTION.

#### SEPSIS AND ANTISEPSIS.

*Sepsis* is a condition caused by the entrance into a wound of bacteria whereby an inflammation, with more or less severe disturbance of the general system, is produced.

*Antisepsis* (meaning germ-destroying) is a term applied to a method of treating wounds which aims at the destruction of germs by germicidal agents.

The subject of sepsis and antisepsis is considered to be one of the most important in all modern surgery, and the application of the principles of antisepsis has done more than anything else to revolutionize the treatment of wounds and prevent sepsis, a complication so dreaded by the older surgeons.

**Causes of Sepsis.**—Why is it that a simple cut will sometimes heal naturally in a few days, and at other times become red, painful, and very swollen, finally healing, it is true, but only after much trouble and discomfort? In the latter case the wound has become infected by bacteria, and poisonous materials have been produced which have prevented its healing. The bacteria may have been conveyed by the instrument producing the wound. They may have come from the hands or from the air, or they may have been present upon the skin and gained entrance through its broken surface. Whatever the mode of entrance may have been, the result is the same,—the bacteria have entered the system, invaded the tissues, and, by their growth, caused putrefaction, or sepsis.

**Bacteria** are microorganisms, or fungi, consisting of minute vegetable cells. They are always present in the air, in the water, in the ground, and upon the body and clothes.



There are many varieties of bacteria, and each requires proper food, temperature, and soil for propagation. Having found a suitable soil or breeding place in the tissues of the body they multiply with a rapidity that is simply marvellous. As they grow and develop, certain poisonous substances, termed *toxines*, are produced, which may act simply as irritants or may destroy all the tissues with which they come in contact,—the effect depending upon the virulence of the bacteria and the resistance of the tissues. In other cases bacteria may gain access to the general circulation and be spread broadcast through the body, exerting their poisonous influence upon every organ which they touch,—in short, producing a general poisoning known as septicemia.

#### GERMICIDAL AGENTS.

**Heat** is the quickest and surest agent known for destroying bacteria. No living germ is able to withstand a temperature of 212° F. (100° C.). Heat, of course, cannot be applied to wounds as a means of sterilization, but it may be used to sterilize water, dressings, or instruments, in the form of dry heat, steam, or boiling water.

Water may be rendered sterile by boiling for half an hour. Instruments are best sterilized by boiling from five to fifteen minutes; a little soda added to the water will prevent rusting.

Dressings or fabrics are usually sterilized by steam under pressure, a sterilizer especially made for this purpose being required. If a sterilizer is not available, an ordinary baking oven may be utilized. The material to be rendered sterile should be wrapped up and securely pinned in a towel or sheet and left in a slow oven at least half an hour, being inspected at short intervals to see that it does not become scorched or burn. In emergencies, the dressings may be sterilized by boiling for fifteen minutes.

**Bichloride of mercury**, or corrosive sublimate, is probably the most frequently used chemical germicide. It is used in a watery solution in a strength of from 1:10,000 to 1:1000.

For the hands it may be used as strong as 1:1000, but for wounds a solution of 1:2000 or 1:5000 is better. A solution of approximately 1:1000 may be prepared by adding seven and one half grains of bichloride to one pint of water. Weaker solutions of any strength may be prepared by diluting the above solution with one, two, three, etc., times as much water. Bichloride of mercury is extremely poisonous, and, having no color or odor, the solution may easily be mistaken for water. To avoid this, it is customary to color solutions with eosin or some other dye. Colored tablets of this drug are manufactured especially for the purpose of making solutions of any given strength. Instruments should never be placed in a solution of bichloride of mercury, as the mercury is deposited upon the steel, and not only tarnishes the instrument but ruins its cutting edge. An inflammation may be produced if the drug is used upon the skin in very strong solutions.

**Carbolic acid** is another excellent germicide and, like corrosive sublimate, is very poisonous. Upon the skin, it may be used in a solution of 1:100. It should be used with care, however, as it is readily absorbed, and poisoning is apt to follow prolonged use. For sterilizing instruments, a solution of 1:20 may be employed. A solution of 1:20 is obtained by adding to one pint of water one and a half tablespoonfuls of pure carbolic acid; a solution of 1:100 would be prepared by adding 1 1/4 teaspoonfuls of carbolic acid to a pint of water.

**Boric acid** is not so powerful a germicide as carbolic acid or corrosive sublimate, but on account of its nonirritating action it has a broader field of usefulness and may be employed about the eyes and in regions where stronger solutions are dangerous. It is usually employed in a saturated solution (5 teaspoonfuls of boric acid dissolved in a pint of water).

**Other Germicidal Agents.**—Among other agents which are germicidal but not as powerful as the above may be mentioned *salicylic acid*, *formalin*, *permanganate of potash*, *iodoform*, *iodine*, *peroxide of hydrogen*, *creolin*, *silver*, *bromine*, *chlorine*, *alcohol*, *aristol*, etc.

## PREVENTION OF SEPSIS—ANTISEPSIS.

To prevent wounds becoming infected by bacteria there are two indications to meet: (1) Prevent germs from entering the wound; (2) destroy or inhibit the growth of germs which may be already present.

**To Prevent the Entrance of Germs.**—This can only be accomplished by the greatest care and cleanliness. The hands, instruments, and everything that comes in contact with a wounded surface must be absolutely clean,—and by clean we mean *surgically clean*, or *sterile*. *Never touch a wound without first cleansing the hands, unless the delay resulting would be dangerous or fatal to the patient.* Do not imagine because a wound is already dirty that lack of cleanliness on your part can do no harm. It is to be remembered that it is quite possible to introduce new and more dangerous forms of infection than are already present.

In treating an ordinary clean wound, first of all thoroughly cleanse the hands by scrubbing for five minutes with a stiff brush in hot water and soap. Then rinse the hands in water that has been boiled, if possible, and finally immerse them for several minutes in a 1 to 1000 solution of bichloride of mercury (one 7 1/2 grain tablet of bichloride of mercury dissolved in a pint of warm water). Having done this, be careful not to touch anything not sterile. Any instruments to be used should be either boiled or placed in a 1 to 20 solution of carbolic acid (1 1/2 tablespoonfuls of carbolic acid to a pint of water). The skin in the neighborhood of the wound should next be carefully cleansed, first with soap and water, followed by the use of some antiseptic. A sterile dressing is then applied to the wound.

Asepsis must of necessity play but a small part in the treatment of emergency cases, yet the observance of its principles is as important in the immediate treatment of wounds as later. It is far easier to prevent damage than it is to repair damage already done; and *we cannot fail to impress those who would render first aid with the importance of observing the strictest cleanliness in handling all wounds.*

**To Destroy Germs already Present.**—In the treatment of a dirty wound, or in a case where we have reason to believe the wound has already become infected, the same care as to the cleanliness of the hands and instruments should be observed as in the treatment of a clean wound. In addition, all particles of foreign matter should be removed, and the wound should be thoroughly washed and irrigated with an antiseptic solution. As a dressing gauze, saturated with some antiseptic, such as carbolic acid or bichloride of mercury, may be used.

#### DISINFECTION.

Disinfection may be said to be a process of destroying infectious material. It is a subject that belongs more especially to the treatment of infectious diseases, but, since a knowledge of the procedure in such cases is of the greatest importance in preventing the spread of diseases, and as it is a subject that is often neglected and but little understood, a short description of some of the methods of disinfection may not be out of place in a work of this kind.

**Disinfecting Excreta.**—During the course of an infectious disease it is important that all excreta and discharges from the patient should be disinfected and destroyed. The urine and feces should be received in a vessel or bedpan containing a solution of 1 to 20 carbolic acid (1 1/2 tablespoonfuls of carbolic acid to a pint of water). The solution used should be of such an amount that it will thoroughly cover the discharges. Care must be taken after coming in contact with such a case to thoroughly wash and disinfect the hands, using for this purpose a solution of 1 to 1000 bichloride of mercury (one 7 1/2-grain tablet of bichloride of mercury to a pint of water) or a 1 to 50 solution of carbolic acid (2 1/2 teaspoonfuls of carbolic acid to a pint of water).

**Disinfecting Bedclothes.**—When bedclothes are removed from the bed they should be soaked in a 1 to 1000 solution of bichloride of mercury (one 7 1/2-grain tablet of bichloride of mercury to a pint of water) before removal from the room; they

should never be taken from the room in a dry condition. They must then be boiled for an hour or two, and, during this time, the lid of the boiler should remain closed,—of course, no food should be cooked on the same stove while this is being done. Should mattresses become contaminated by discharges they must be burned, unless they can be disinfected in a steam sterilizer.

**Disinfecting a Room.**—The disinfecting and cleansing of a room occupied by an infectious case should be carried out with great care and thoroughness. The room should first be fumigated. For this purpose either sulphurous acid gas or formaldehyde gas may be used. Of the two, formaldehyde gas is to be preferred as it is superior to sulphur as a germicide and does not bleach or destroy fabrics; at the same time it will not kill rats, mice, roaches, bed-bugs, mosquitoes, or lice. Sulphur, on the other hand, is most destructive to animal life, and, for this reason, should be employed for fumigation after yellow fever, plague, or other diseases which are transmitted by mosquitoes or vermin. In either case, the room must first be sealed as thoroughly as possible to prevent any gas escaping; all keyholes, cracks, and crevices about the doors and windows should be carefully plugged with cotton or felt.

The simplest method for fumigating with formaldehyde is that known as the formalin-permanganate method. It is carried out as follows: A tub containing several inches of sand or water is placed on the floor in the center of the room, and into this is set a galvanized iron pail, about 12 inches high, 10 inches in diameter at the bottom, and somewhat wider at the top, which contains 8 ounces of permanganate of potash for each 1000 cubic feet of space to be fumigated. Sixteen ounces of formalin for each 1000 cubic feet of space are then poured upon the permanganate crystals. A reaction promptly occurs between the permanganate of potash and the formalin with the production of formaldehyde gas. The person having the fumigation in charge should, therefore, leave the room and seal the door as soon as the two chemicals are brought in con-

tact. The room should not be opened for 6 or 8 hours. Formaldehyde is a most penetrating gas, and after its use a room is uninhabitable for some hours. In place of the above method, a special formaldehyde gas generator is manufactured to be placed outside the room, the gas being discharged through a keyhole by a tube leading from the generator.

Fumigation with sulphur is generally carried out as follows: A washtub or large pan is placed in the center of the room with about two inches of water in it, to prevent any burning sulphur spilling over and setting fire to the floor. Over this tub of water is placed a smaller pan resting upon two bricks. This pan contains the sulphur broken in small pieces. The sulphur may be ignited by dropping a hot coal on it, or by first saturating it with alcohol and then lighting with a match. Sulphur may also be obtained in the form of candles especially made for this purpose. The sulphur should be allowed to burn until consumed, and the room should not be opened for twenty-four hours. The amount of sulphur required will depend on the size of the room; to fumigate thoroughly, however, about five pounds of sulphur should be used to each 1000 cubic feet of space.

In addition to fumigating the room, and as an added precaution, the walls should be brushed down, and all curtains or hangings should be removed and washed. The woodwork and floors should also be scrubbed, first with soap and water, and then with a 1 to 1000 solution of bichloride of mercury (one 7 1/2-grain tablet of bichloride of mercury to a pint of water).

After fumigating and cleaning a room, leave all the doors and windows open for several days to let in the air and sunlight, as they are the best disinfectants that could be employed.

PART III.  
ACCIDENTS AND EMERGENCIES.

CHAPTER XIII.

**HEMORRHAGE.**

Hemorrhage or bleeding may be defined as an escape of blood from the heart or blood-vessels. The cause is usually some injury or a diseased condition of the vessels.

A profuse hemorrhage from a large artery is one of the most troublesome forms of accident that one is called upon to treat, and to be successfully controlled requires presence of mind and promptness, as frequently the delay of a few moments may be followed by a fatal result. The danger from a hemorrhage depends upon the amount of blood lost and the rapidity with which it escapes,—a loss of one-third the amount of blood in the body usually results fatally, and a sudden escape of blood is much more dangerous than a slow or gradual hemorrhage.

**Varieties of Hemorrhage.**—(1) **Arterial Hemorrhage** is the result of the wounding of an artery. The blood is bright red in color and *escapes in spurts*. No pulsation can be obtained in the vessel below the seat of injury. Pressure upon the vessel between the wound and the heart arrests the bleeding.

(2) **Venous Hemorrhage** is bleeding from a vein. The blood is dark red or blue in color and *flows in a continuous stream*. Pressure upon the vessel beyond the seat of injury controls the bleeding.

(3) **Capillary Hemorrhage** is a general oozing of blood from a cut or abraded surface.

**Symptoms of Hemorrhage.**—Hemorrhage may cause immediate death or simply result in syncope or collapse. Nearly all severe hemorrhages are accompanied by more or

less shock. The skin is cold and pale; the body is covered with a profuse perspiration; the pulse becomes rapid and then feeble; the respirations are shallow and sighing. The person complains of darkness before the eyes, roaring in the ears, and difficulty in breathing, and continually begs for water. If recovery takes place, the patient remains pale and anemic for some time; and frequently a condition known as hemorrhagic fever supervenes.

**The Spontaneous Arrest of Hemorrhage.**—Fortunately, in the majority of cases, hemorrhage is arrested by nature before a fatal loss of blood occurs. When a vessel is cut through, the muscular fibers in its wall begin to contract, and at the same time the vessel's wall retracts within its sheath, so that the caliber of the vessel at the point of injury is partially closed or, at least, becomes very much smaller. The blood, coming in contact with the air and meeting the resistance of the narrowed vessel wall, begins to coagulate or clot, and soon a plug is formed which completely closes the end of the vessel and prevents any further escape of blood. The formation of this clot is also aided by the action of the heart, which, as a result of the hemorrhage, becomes weaker, and the blood is propelled through the vessels with less force. Thus a condition of the circulation is produced which not only favors clotting of the blood but also prevents the clot being immediately washed away as it forms. Later the clot becomes organized and forms a permanent plug of the vessel.

**Means of Controlling Hemorrhage.**—The surest method of stopping a hemorrhage is to catch the vessel up with a pair of forceps and tie it. In emergency cases, however, this is impossible as a rule, and our aim should be to temporarily control the hemorrhage until more thorough treatment can be pursued.

Hemorrhage may be controlled by (1) pressure; (2) position; (3) heat or cold; (4) styptics; (5) torsion; (6) ligation.

(1) **Pressure** stands first and foremost as a temporary means of stopping hemorrhage. It may be applied by the finger, by compresses, by tourniquets, and by constricting bands.



It should be remembered that *if the hemorrhage is from an artery, the pressure must be applied at some point between the wound and the heart; if the bleeding is from a vein, the pressure must be applied on the side of the wound farthest from the heart.*

*Digital pressure*, usually effected by the thumb, may be applied directly to the bleeding vessel or at some point along its course. It should be applied in such a manner as to include the vessel between the finger and some *bony* part. Digital pressure, however, can only serve for a short time, as the fingers soon become tired.



FIG. 139.—Method of making digital compression of an artery.

*Pressure by Means of Compresses* may be effected as follows: A number of small pieces of gauze or linen, or a tampon, previously rendered sterile or antiseptic, are placed in the wound one on top of the other until there are a sufficient number to compress the bleeding vessel. A bandage is then firmly applied to hold them in place and exert the necessary pressure. Sometimes more effective pressure can be obtained by employing a

compress of gradually increasing size. Several small pieces of linen or gauze of about the size of a cent are first laid upon the point at which the compression is to be made, and upon these are placed larger pieces, thus forming a cone-shaped compress, as shown in Fig. 140. Compresses may be applied in the same manner along the course of the vessel.



FIG. 140.—The action of a graduated compress upon an artery (Senn).

*Pressure by Means of Tourniquets or Constricting Bands* is a most useful method of controlling hemorrhage, but has the disadvantage that if prolonged for any length of time it is apt to be painful and may produce severe damage to the tissues.

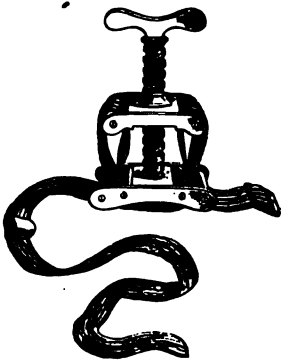


FIG. 141.—Petit's tourniquet.

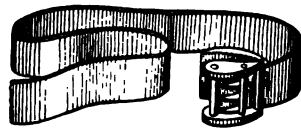


FIG. 142.—The field tourniquet.

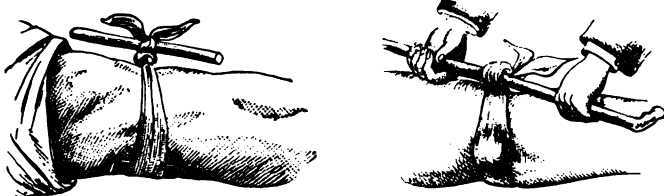
There are various kinds of tourniquets, of which Esmarch's tourniquet, Petit's tourniquet, and the field tourniquet are examples. The manner in which they are applied may readily be understood from the accompanying illustration (Fig. 143). In an emergency, a tourniquet can easily be improvised which will serve all practical purposes. All that is needed is some

strong material, like a towel, a belt, a rope, a bandage, or a handkerchief to encircle the limb, some round, hard body, such as a stone, cork, or piece of wood to act as a compress, and a short stick to tighten the tourniquet. Take the handkerchief



FIG. 143.—The application of the field tourniquet.

or towel, and, after folding it in the form of a cravat, place in its center the compress and tie it loosely around the limb in such a manner that the compress will be directly over the course of the bleeding artery at some point between the wound and the heart. A stick is then placed through the loop on the opposite side of



FIGS. 144, 145.—Improvised tourniquets made with a handkerchief and stick (Stoney.)

the limb and is twisted around until the tourniquet is tightened and the compress, acting on the vessel, stops the hemorrhage.

In controlling hemorrhage by simply constricting a limb, a piece of rubber tubing or a stout rubber band may be utilized.

The band is wrapped about the limb several times with sufficient tension to compress the bleeding vessel.

(2) **Position.**—Much may be accomplished in arresting hemorrhage from a small vessel by simply elevating the part, and even when the hemorrhage is from a large vessel it is useful if employed in conjunction with pressure or other methods. Sometimes bleeding from an extremity may be controlled by forcibly flexing the joint just above the seat of the hemorrhage, thus bending the vessel upon itself. This is more



FIG. 146.—Elastic constriction of thigh (Senn).

efficacious, however, if a compress or pad be first placed in the fold of the joint; the limb is then flexed and held in this position by a bandage (Fig. 147).

(3) **Heat and Cold** control hemorrhage by producing a contraction of the vessel wall and coagulation of the blood. They act best in capillary hemorrhage or hemorrhage from a very small vessel, but are of little or no value for controlling bleeding from a large artery. Cold may be applied in the form of ice, ice water, or snow. Heat may be applied by means of cloths wrung out in very hot water. Heat, however, is useless unless employed at a high temperature (120° F.). Warm water

simply produces a dilatation of the vessels, increasing instead of arresting a hemorrhage.

(4) **Styptics** are substances which arrest hemorrhage by producing coagulation of the blood or contraction of the vessel wall; they must be brought into actual contact with the bleeding vessel to have any effect, and are only employed in



FIG. 147.—Forced flexion of the elbow.

arresting hemorrhage from regions inaccessible to other forms of treatment, as they are apt to soil a wound and thus frequently interfere with its healing. The principal styptics are alum, tannic and gallic acid, suprarenal extract, antipyrin, persulphate of iron, alcohol, and turpentine.

(5) **Torsion** consists in twisting the end of a vessel with forceps or an artery clamp for five or six rotations. It is unsafe to apply this method to large vessels.

(6) **Ligation** is the surest and safest method we have for

permanently controlling hemorrhage. Ligatures of catgut or silk, thoroughly sterilized, may be used. Ligation of a vessel is very easily accomplished provided the necessary instruments are at hand. The vessel is simply caught up in a pair of forceps, and a ligature placed around it and firmly tied. In the case of a divided artery, both ends of the vessel should be found and tied.

Twisting and tying, however, are unsafe methods to be employed by one unskilled in surgery.

**Treatment of Hemorrhage.**—The indications are, first, to stop the bleeding and then treat the shock or collapse which commonly results.

(1) **The Immediate Treatment of Arterial Hemorrhage.**—Arterial hemorrhage is the most dangerous form of bleeding with which we have to deal. The blood is flowing directly from the heart, and promptness in treatment is of prime importance. Do not wait for compresses or a tourniquet. Remember, we always have *in our hands* a most efficient means of controlling hemorrhage. Compress the bleeding vessels at some point between the wound and the heart, or, if the location of the bleeding artery is not known, simply tie a bandage or rope tightly around the limb above the injury. With the bleeding once under control, we can then take our time and direct some one how to prepare and apply a tourniquet or compress. Finally, a sterile pad or compress should be applied to the wound, and the patient kept absolutely quiet with the part elevated until the arrival of medical assistance.

(2) **The Immediate Treatment of Venous Hemorrhage.**—In this form of hemorrhage the blood is flowing toward the heart, so apply pressure on the side of the wound farthest from the heart, being careful to remove any constriction from between the wound and the heart. The application of a compress to the wound is usually sufficient to stop the hemorrhage.

(3) **The Immediate Treatment of Capillary Hemorrhage.**—As a rule, simply exposure to the air or the application of heat

or cold will suffice to stop the bleeding. If not, a compress and bandage applied to the wound are all that is necessary.

(4) **The Constitutional Treatment of Hemorrhage.**—It should not be supposed that after we have stopped a hemorrhage we have done all that is necessary. Frequently, following a severe hemorrhage, the patient suffers from serious shock and is in such a state of collapse that only the most energetic measures will save his life.

In the absence of a physician, have the patient immediately put to bed, with the head lowered, and the body covered warmly with blankets. Apply heat to the heart and extremities by means of hot-water bottles or hot-water bags (see also page 162), *but do not give any stimulants*, as they may start up a fresh hemorrhage. In cases of great loss of blood, a pint or two of hot saline solution should be given in an enema by the rectum (see page 166). When the patient is almost exsanguinated or fatally exhausted from the loss of blood, bandages should be applied to the extremities for the purpose of driving what little blood they may contain to the vital organs.

#### CONTROL OF HEMORRHAGE FROM SPECIAL REGIONS.

**Hemorrhage from the scalp** can usually be controlled by compression against the skull at the seat of injury. If the bleeding be profuse, we may temporarily employ digital pressure over one or both temporal arteries (Fig. 149). They can be felt pulsating just in front of the ears.

**Hemorrhage from the Face.**—The face is supplied by the facial artery, which passes upward from the neck, crossing the lower jaw about half way between the ear and the chin, and supplies the lips and nose. It may be felt pulsating as it crosses the lower jaw and can readily be compressed in this locality (Fig. 150). Bleeding from the lips may be controlled by grasping them between the thumb and forefinger and exerting pressure.

**Hemorrhage from the Neck.**—The neck is supplied by the carotid arteries. They pass upward in a course indicated

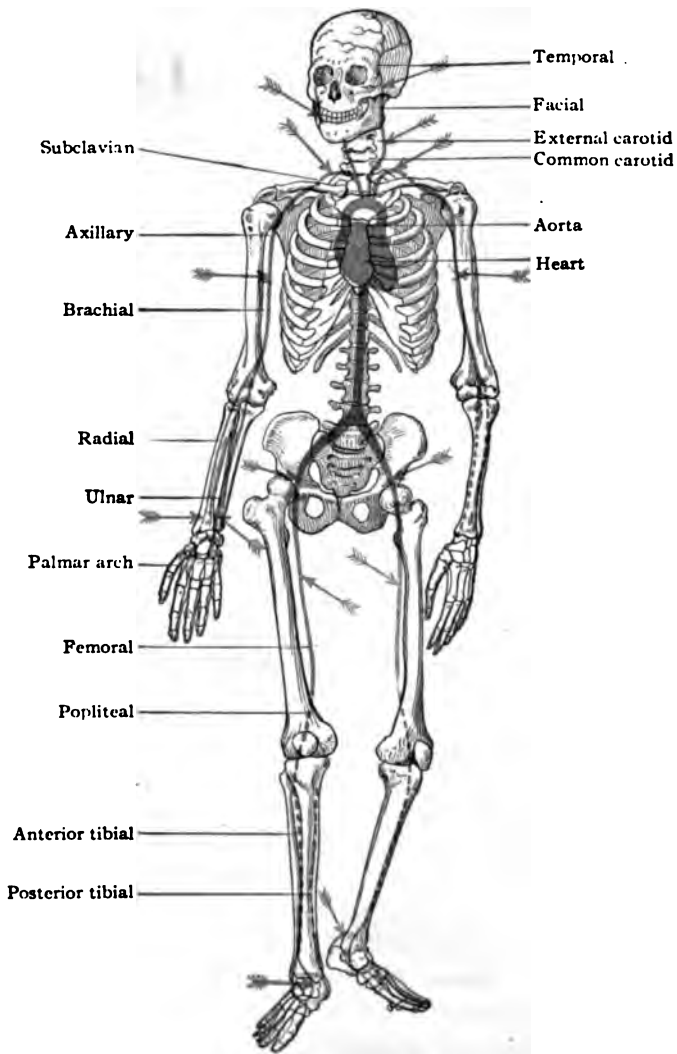


FIG. 148.—The relation of the principal arteries to the bones. The arrows indicate the points where pressure may best be applied.



by a line extending from the junction of the clavicle and ster-



FIG. 149.—Compression of the temporal artery.

num to a point a little behind the angle of the jaw. The vessel may be compressed between the finger and the spinal col-



FIG. 150.—Compression of the facial artery.

umn (Fig. 151), but *never apply a tourniquet to the neck*, as such

a procedure would strangle the individual. The carotid artery may be wounded in cases of attempted suicide by cutting the throat; if so, the injury is usually on the left side.

**Hemorrhage from the Shoulder.**—Pressure should be applied to the subclavian artery. It is usually difficult to locate; but in thin persons it may be felt pulsating behind the middle of the collar-bone. It may be compressed here between the thumb and first rib (Fig. 152); or, as is sometimes done, a key padded as shown in the accompanying illustration (Fig. 153) may be substituted for the thumb.



FIG. 151.—Compression of the carotid artery.



FIG. 152.—Compression of the subclavian artery.

**Hemorrhage from the Armpit.**—The armpit, or axilla, is supplied by the axillary artery, a continuation of the subclavian. Hemorrhage from wounds in this region may be controlled by placing a pad in the armpit and binding the arm tightly to the side. If this fails, pressure should be applied to the subclavian artery (Fig. 152).

**Hemorrhage from the Arm.**—The arm is

supplied by the brachial artery, a continuation of the axillary. It runs down on the inner side of the arm from the junction

of the outer and middle third of the axilla to the center of the bend of the elbow. It can readily be felt pulsating just internal to the biceps muscle; pressure may be applied here by the fingers or tourniquet (Fig. 154).

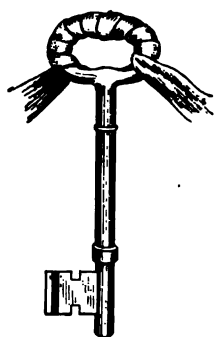


FIG. 153.—Handle of door-key padded (Da Costa).

#### **Hemorrhage from the Forearm.**—

The forearm is supplied by the radial and ulnar arteries, which are branches of the brachial artery given off just below the bend of the elbow. The radial artery passes down the outer side of the forearm, and can be felt at the wrist as the radial pulse. The ulnar artery passes down the inner side of the arm and can only be felt with difficulty at the wrist, as at

this point it is covered by tendons. Both vessels lie deeply imbedded in the muscles of the forearm in the upper portion of their course. Bleeding from the forearm may best be controlled by compression of the brachial artery at some point in the arm (Fig. 154); or a pad may be placed in the bend of the elbow and the forearm forcibly flexed on the arm (see Fig. 147).

#### **Hemorrhage from the**

**Hand.**—The hand is supplied by the terminal branches of the radial and ulnar arteries, which unite to form two palmar arches. It is one of these arches that is usually cut in deep

wounds of the hand. Bleeding from the hand can be controlled by pressure upon the brachial artery in the arm or at



FIG. 154.—Compression of the brachial artery.

the elbow, or by compression of the radial and ulnar arteries just above the wrist (Fig. 155). Hemorrhage from the palm may frequently be controlled by placing a large, firm compress in the palm, with the fingers *very lightly* closed over it and bandaged in place.

**Hemorrhage from the Thigh.**—The thigh is supplied by the femoral artery, which passes downward on a line extending from the middle of the groin to the inner side of the knee. It is quite superficial in the upper part of its course, and may be compressed here by the fingers (Fig. 156), by a tourniquet (Fig. 143), or by the forcible flexion of the thigh upon the abdomen. In the lower part of its course, the artery passes to the back of the thigh and knee, and is then known at the popliteal artery. It may be compressed in this region by placing a pad or compress behind the knee-joint and forcibly flexing the leg on the thigh (Fig. 157).



FIG. 155.—Compression of the radial and ulnar arteries at the wrist.

**Hemorrhage from the Leg.**—The leg is supplied by the anterior tibial artery, which passes down the front and outer side of the leg, and by the posterior tibial artery, which passes down the back of the leg. Both of these vessels are branches of the popliteal artery and both lie deeply in the upper part of their course, but approach the surface as they near the ankle-joint. Compression should be applied to the femoral artery or to the popliteal artery at the knee.

**Hemorrhage from the Foot.**—The foot is supplied by



FIG. 156.—Compression of the femoral artery.

two plantar arteries, which are branches of the posterior tibial artery. Bleeding from the dorsal surface of the foot may be controlled by compression of the anterior tibial artery at the instep. In bleeding from the sole of the foot, compression may be applied to the posterior tibial artery just behind the internal malleolus.

#### THE TREATMENT OF SPECIAL FORMS OF HEMORRHAGE.

##### **Hemorrhage from the Nose (Epistaxis).**

—As a rule, bleeding from the nose is slight and soon stops of its own accord. If the bleeding is persistent, have the patient remain quiet; remove the collar or any constriction from the neck; apply cold or ice to the back of the neck, and instruct the patient not to blow his nose. A solution



FIG. 157.—Forced flexion of the knee.

of strong tea, alum, antipyrin, or suprarenal extract injected or snuffed into the nose will often stop the bleeding by causing a clot to form.

Should these simple measures fail, the bleeding nostril will have to be packed. This can readily be done by taking any soft material—cotton, linen, or lint—and gently forcing it well back into the nose. If the bleeding still continues, we may be sure it comes from some point behind or deep in the nose, and for such a case medical assistance should be obtained.

**Hemorrhage After Extraction of a Tooth.**—At times persistent bleeding may follow the extraction of a tooth, but the application of ice, or a plug placed in the cavity and held there by the closed jaws, will usually suffice to stop it. Should this fail, pack the cavity tightly with cotton or linen saturated in a solution of alum, strong tea, or some other styptic; then have the jaws closed, and apply a Barton's or four-tailed bandage to hold them in position.

Above all, the patient should be cautioned against spitting or continually swallowing, as these actions produce a suction in the mouth and simply prolong the hemorrhage; if saliva and blood collect in the mouth the patient's head should be turned to one side so they can escape from the corner of the mouth.

**Hemorrhage from Varicose Veins.**—The term varicose veins is applied to a dilated condition of the veins, usually due to a weakened vessel wall or to causes that interfere with the circulation in the veins, such as the wearing of tight clothing.



FIG. 158.—Varicose veins (Burrell).

It is a condition that may occur in any locality, but is generally seen in the veins of the legs. Rupture of one of these dilated veins is very apt to occur and may result in a profuse hemorrhage. Elevation of the part and the application of a compress to the wound will generally be all that is required.

Following such an accident, the patient should be kept absolutely quiet and flat on the back.

**Internal Hemorrhage.**—Internal hemorrhage, also spoken of as concealed hemorrhage, may occur in any of the cavities and from any of the organs of the body as the result of injury or disease. It is a condition which may be very difficult to diagnose, as the hemorrhage cannot be seen, and we frequently have only the symptoms of shock. In such cases procure the services of a physician immediately; in the meantime, put the patient to bed and keep him absolutely quiet.

**Hemorrhage from the Lungs (Hemoptysis)** may result from wounds of the lung, but is more often due to a diseased condition of that organ. The patient is seized with a fit of coughing, and spits up bright red, frothy blood. Unfortunately, nothing can be done to directly control the hemorrhage. The treatment, in the absence of a physician, consists in absolute quiet, rest in bed in the recumbent position, and the use of ice by the mouth. *Avoid the use of stimulants.*

**Hemorrhage from the Stomach (Hematemesis)** is due to an injury or a diseased condition of the vessels of the stomach wall. The patient has a sense or feeling of fullness in the region of the stomach, perhaps accompanied by some pain which is soon followed by the vomiting of dark, clotted blood, often described as resembling "coffee grounds." It should be remembered that vomiting of blood is not always a sign of hemorrhage from the stomach; the vomited blood may have originally come from the mouth or nose and have been swallowed. In the absence of a physician, treat this condition by rest in bed and by giving ice in small quantities by the mouth, but *do not use stimulants and avoid giving any food for some time afterward.*

**Consecutive and Secondary Hemorrhage.**—Hemorrhage recurring within twenty-four hours after an injury is spoken of as a consecutive hemorrhage. If it comes on after the first twenty-four hours it is known as a secondary hemorrhage.

Recurrence of a hemorrhage may be due to the heart acting with such force as to wash away blood clots which have formed in the vessel, or it may be the result of sloughing of the vessel following infection. As a rule, elevation of the part and compression of the bleeding vessel generally suffice to stop the flow of blood. If this fails, apply a tourniquet until the arrival of surgical aid. In gunshot wounds or, in fact, any wound where we might expect recurrence of the hemorrhage, it is well to have a tourniquet loosely applied to the part, so that it may be tightened immediately if required. Where the hemorrhage is the result of infection, it will usually be necessary for the surgeon to clean out the wound and secure the vessel by ligation at some point higher up.



## CHAPTER XIV.

### CONTUSIONS AND WOUNDS.

#### CONTUSIONS.

A contusion, commonly called a bruise, is a crushing of the tissues usually without any breaking of the skin. Contusions are caused by blows from blunt instruments or follow compression produced by heavy forces.

They are characterized by swelling, tenderness, and a discoloration due to an escape of blood into the tissues as the result of the rupture of small vessels in the neighborhood of the injury. At first the discoloration is red, then blue or black, and finally turns yellow or green. A severe contusion may result in rupture of one of the large vessels, causing a subcutaneous hemorrhage or collection of blood in the tissues known as a *hematoma*. In such cases the contused area is very liable to become infected through the skin and an abscess may result. The pain in a contusion is ordinarily dull or aching and rarely lasts long. Shock, however, is frequently present in the more severe forms.

**Treatment.**—We should remember that following a severe contusion the vitality of the tissues is much impaired, and a good soil is present for infection; hence, the injury should be treated with some care. The skin over the contused area should be first *gently* but thoroughly scrubbed with soap and water, followed by the use of an antiseptic solution, such as a 1-1000 solution of bichloride of mercury (one 7 1/2-grain tablet of bichloride of mercury dissolved in a pint of boiled water). If any small cuts or abrasions be present, keep them covered with a piece of clean cotton or gauze.

Of the local applications for the relief of pain and the reduction of swelling, cold is the best in the early stages. It may

be applied by means of cloths wrung out in ice water and frequently changed, or by the use of the ice-bag or ice-cap (see page 161). The use of cold should be avoided if the contusion is a very severe one or if the injury is in an old person, as in such cases the tissues have but little vitality, and the prolonged application of cold may interfere with the nutrition of the part or be followed by a destruction of the tissues. In these cases hot applications will be better. Both heat and cold are more efficacious if they are accompanied by the use of moderate pressure applied directly to the injured part. Pressure prevents the further escape of blood and also assists in the absorption of that already present. Other remedies that act well and are frequently found to relieve pain include many astringent solutions, such as lead-water and laudanum, aluminum acetate, dilute alcohol, dilute vinegar, etc.

In addition, the contused part should, if possible, be elevated and put at rest—elevation helps to prevent the escape of blood into the tissues, and rest is important from the fact that any unnecessary movements of the part are not only painful to the sufferer, but are also liable to add to the damage already present. Rest of the injured part may be secured by the use of bandages or, if the extremities are affected, by means of slings or splints.

Later, when all inflammation has subsided, properly performed massage is useful in aiding in the absorption of the effused blood and in restoring the function of the part.

**Black Eye.**—A black eye is simply a form of contusion, but on account of the resulting discoloration and the disfigurement which is apt to occur it is a very troublesome form of injury.

**Treatment.**—When discoloration has appeared but little can be done to remove it; but, if seen early enough, judicious treatment will do much in preventing or at least limiting its development. Hot or cold applications to the eye with firm pressure immediately after injury are the best remedies. Later, absorption of the blood may be hastened by gentle massage.

### WOUNDS.

A wound is a break or a division of the continuity of the tissues usually produced by sudden force.

All wounds are accompanied by one or all of the following signs or symptoms: pain, hemorrhage, loss of function, and retraction of the cut edges, while if the injury is very severe, there is produced, in addition, a general condition of depression affecting the vital functions, known as *shock*.

**The Repair of Wounds.**—When tissues are cut, the edges always retract, there is more or less hemorrhage, and the space between the cut edges becomes filled with a blood-clot. Where the edges of the wound are brought into apposition, and unless there is some infection present, only a slight inflammation occurs as a result of the violence to the tissues, shown by some little redness, swelling, and pain about the cut edges. This rapidly subsides, however, and the skin, connective tissue, and other tissues that may be cut, send out new cells similar to those of which they are composed to repair the damage. These cells enter the blood-clot and form new tissue; at the same time, small buds or loops will be seen springing from the cut capillaries and vessels, which permeate the blood-clot and mass of new cells and form blood-vessels for this new tissue. This is called healing by first intention or apposition.

Should the edges of a cut be allowed to gape open, or should there be a considerable loss of tissue at the time of injury, or suppuration of the wound result, healing occurs by second intention or granulation. The same steps occur as in healing by first intention, the only difference being in the amount of new tissue to be formed. There is a blood-clot formed, a pouring out of new cells, and the appearance of new blood-vessels; in addition small red elevations, known as granulations or more commonly as “proud flesh,” appear on the surface of the new tissue, gradually filling up the gap between the divided edges of the wounds as the new tissue forms from below. When the level of the divided surface is reached, cells grow out from the edges over the granulating surface, and thus the repair is

effected. The new-formed tissue is now known as a "scar" or cicatrix. It is at first red or pink and of the same extent as the wounded surface; later it becomes white, and through contractions its area is diminished.

**The General Treatment of Wounds.**—The indications are to arrest hemorrhage, to combat shock if present, to clean the wound, and finally to apply an occlusive dressing.

**The Arrest of Hemorrhage.**—The various means at our disposal for stopping hemorrhage have been described in the chapter on that subject (see page 177). Remember that we can control the bleeding temporarily by the use of pressure, a compress, or a tourniquet, but later the bleeding vessel, if a large one, should be caught up and tied by a surgeon.

**The Treatment of Shock.**—Endeavor to bring about reaction slowly by the use of heat applied to the heart and extremities. Place the patient prone, with the head low, and cover up warmly with blankets. Avoid the use of stimulants, or use only with precaution. (For further treatment of shock see page 281).

**To Cleanse the Wound.**—All wounds should be thoroughly cleansed before they are dressed. *Remember to cleanse the hands by a thorough scrubbing with a nail brush for five minutes in soap and warm water before handling a wound and to bring nothing in contact with the wounded surfaces which is not sterile, or at least clean.* This is of the utmost importance, for, if a wound becomes contaminated, inflammation will develop with the formation of a discharge and not only will healing be delayed, but a general infection (blood poisoning) may be the result. If there is much hair about the part, it should be removed by cutting or shaving—say for a distance of several inches from the cut edges. Then wash the skin with soap and water, and follow by the use of some antiseptic solution, as a 1:1000 solution of bichloride of mercury (one 7 1/2-grain tablet of bichloride dissolved in a pint of warm water) or a 1:100 solution of carbolic acid (1 1/4 teaspoonfuls of carbolic acid to a pint of water). In cleansing the wound be careful to avoid

rough handling of the wounded surfaces, as such treatment only adds to the severity of the injury and often delays union.

Some wounds, especially lacerated wounds, will be fairly ground in with dirt and grease, so that it would seem impossible to cleanse them. In such cases the use of a little turpentine will aid greatly in cleansing the part by dissolving the grease. Before applying the dressing always examine the wound for the presence of foreign substances, such as pieces of glass, splinters, portions of clothing, or other bodies which may have become imbedded in the tissues. These should always be carefully removed. In some cases it may even be necessary to enlarge the wound before it is possible to remove the foreign body; *this, of course, should be left to a surgeon.*

**To Dress the Wound.**—If a physician is near, a temporary dressing only need be applied. Such a dressing aims to protect the wound from the air and prevent the entrance of germs. With this end in view simply cover the wound, *without handling it*, with a piece of sterile gauze, or, in its absence, with cotton, linen, or lint which has been boiled for five minutes, and apply a bandage.

*In the absence of medical assistance*, some attempt should be made to bring the edges of the wound together. Of course the use of sutures is the best means for accomplishing this, but as a substitute, strips of plaster may be employed. If one feels confident of his ability to do so, there is no harm in sewing a wound in cases where medical attention cannot be obtained for days. For sutures, catgut, if available, is the most convenient, as it will not require to be removed; silk sutures, if used, are to be removed in six or seven days. In the absence of surgeon's needles and sterilized sutures, ordinary strong cambric needles threaded with silk may be employed. They should be boiled, together with a pair of scissors, for at least five minutes. Then, with the operator's hands and the wound cleansed as described above, the needle, threaded with the suture, is passed through the skin about one-eighth inch from the cut edge and on out through the opposite side at a

corresponding point. The suture is then tied and the ends cut leaving about one-quarter inch remaining. Care should be taken in tying the suture to use but little tension—sufficient only to bring the cut edges in accurate approximation. The remaining stitches are inserted in the same manner at a distance of from one-quarter to one-half inch apart until the wound is closed (Fig. 159).

Narrow strips of adhesive plaster—say one-quarter to one-half inch wide—may be used in the place of sutures if applied at intervals across the edges of the wound in sufficient number to hold the cut surfaces in apposition. Plaster strips should



FIG. 159.—The interrupted suture (Zuckerkandl).

never completely encircle the limb, as they then act as constricting bands, interfering with the circulation. Care should be observed, in removing the plaster, to pull it off from both ends *toward the wound*, so as not to pull the wound open. (For the application of adhesive plaster as sutures, see also page 151.)

As a rule the edges of large, deep wounds should not be too tightly apposed. Some chance of escape should be left for the serum and secretions which are sure to be present—in other words, means of drainage should be supplied. This may be effected by the use of small pieces of sterile rubber tubing, strands of catgut or silkworm-gut; or a narrow strip of gauze, which has been sterilized by boiling, may be placed in the lower angle of the wound. Wounds which are dirty or already infected should always be drained.

After the edges of the wound have been properly brought together, a sterile dressing is applied and is secured in place by bandages or adhesive plaster.

Finally, the injured part should be given as complete a

rest as possible, so that healing may go on undisturbed. In cases where the extremities are wounded, slings or splints should be applied for this purpose.

Unless the wound throbs and becomes painful, the dressings need not be disturbed for six or seven days, at which time the same care as to cleanliness should be observed as in the original dressing. If the wound becomes infected and a discharge of matter develops it is best treated with a wet antiseptic dressing—that is, a dressing kept saturated with some antiseptic solution, such as a 1:5000 solution of bichloride of mercury (one  $7\frac{1}{2}$ -grain tablet of bichloride of mercury to 2  $\frac{1}{2}$  quarts of water) and covered with oil-silk or rubber tissue to retain the moisture. It is well to surround the whole dressing with an abundance of cotton or gauze to absorb discharges. Such dressings should be renewed every day, at which time any discharge should be washed away with boiled water or a 1:1000 bichloride solution (one  $7\frac{1}{2}$  grain tablet of bichloride of mercury to a pint of water).

#### SPECIAL FORMS OF WOUNDS.

Wounds are classified as incised, lacerated, contused, punctured, gunshot, or poisoned.

**Incised Wounds** are produced by some sharp cutting instrument, such as a knife, a sword, or a piece of glass, the tissues being cleanly divided without any bruising or tearing. They are accompanied by a sharp burning pain due to injuries to the terminal nerves. They are apt to gape widely, and, as a rule, bleed freely. Especially is this so if the wound is situated upon the face, scalp, or hands, where there is a liberal supply of blood-vessels.

**Treatment.**—The general rules for the treatment of wounds detailed on page 197 should be followed. If the wound is clean simply bring the cut edges together by the use of strips of plaster or by sutures and dress with sterile gauze. An incised wound, if clean, should heal in from seven to ten days.

Incised wounds about the wrist are serious, as they are

frequently complicated by the division of some of the tendons or nerves. A patient suffering from such an injury should, therefore, always consult a surgeon at the earliest possible moment, so that, if the tendons or nerves be cut, the divided ends may be sought for and united with sutures. Should this be neglected the hand may be rendered useless.

**Lacerated Wounds** are the result of a tearing of the skin and tissues by blunt instruments or machinery. They present ragged edges, which do not retract much, and which, as a rule, consist of masses of torn tissue, frequently ground in with dirt. The pain in a lacerated wound is dull or aching in character; the hemorrhage is slight owing to the twisting and tearing to which the ends of the injured vessels are subjected. There is usually an excessive amount of shock with this form of injury; and, owing to the extensive tearing of tissues, infection, sloughing, and secondary hemorrhage are liable to occur.

**Treatment.**—Lacerated wounds are very prone to infection, and should always be thoroughly cleansed. Be careful to remove all dirt and dead tissue. As a rule no attempt need be made to approximate the edges of small lacerated wounds. It is better to leave them open and allow discharges and secretions to escape. If, however, the wound is an extensive one, the edges may be loosely drawn together by one or two sutures or strips of adhesive plaster, provided room is left for free drainage. Then dress the wound as already described on page 198. Shock will also require appropriate treatment (see page 281).

**Contused Wounds** are those in which the division of tissues is accompanied by more or less severe crushing. Such wounds are caused by heavy blunt forces. External hemorrhage is, as a rule, slight, but there may be considerable bleeding into the surrounding tissues. Breaking down of the blood-clot and sloughing are liable to occur later.

**Treatment.**—Treat by the same methods described above for lacerated wounds.



**Punctured Wounds** are produced by thrusts from pointed instruments, and sometimes from needles, thorns, pieces of glass, splinters of wood, steel, etc. They are generally small in size, but may be of great depth. When caused by small, smooth, clean instruments they are usually trivial; but, if produced by splinters or by instruments which we have reason to believe are dirty, they become dangerous on account of the liability to infection. Pain in punctured wounds is slight, nor is hemorrhage severe as a rule.

**Treatment.**—When produced by a clean instrument, simply apply a sterile dressing, first, however, thoroughly washing the skin with soap and warm water and then with a 1:1000 solution of bichloride of mercury (one 7 1/2-grain tablet of bichloride of mercury dissolved in a pint of boiled water).

*When medical or surgical assistance cannot be obtained*, dirty punctured wounds should in addition be swabbed out with pure carbolic acid or with tincture of iodine, applied by means of a small bit of cotton wrapped on the end of a probe or a sharpened match stick, care being taken to remove any excess of acid from the cotton before the application is made. The wound should then be lightly packed with a narrow strip of sterile gauze, and an antiseptic pad applied. In all cases any foreign bodies should be removed.

A splinter should be pulled out straight, care being taken not to break it off. Sometimes splinters imbedded in an extremity, as a toe or finger, may be removed by tightly wrapping a piece of rubber band about the part from below up to the point where the splinter is located. This serves to depress the tissues from the splinter, the end of which will thus be made to project above the skin sufficiently to be lifted out with a sharp-pointed knife.

**Gunshot Wounds.**—Under this head are included wounds produced by rifle and pistol balls, small shot, and shell.

In gunshot wounds there is a wound of entrance and usually one of exit, but there may be only one wound, or the same bullet may produce several wounds. These wounds are always

accompanied by more or less contusion and laceration of the tissues, depending on the kind of missile producing the injury. This destruction of tissues, known as the "explosive effect," is present for some distance around the track of the missile and is caused by the bullet's sudden impact and rotation in the tissues. Its severity depends on the velocity of the bullet. The old-fashioned guns produced this effect only at a short range, but modern rifles can produce it at a distance of five hundred yards or more. Bullet wounds are dangerous from the fact that they are liable to infection, especially if portions of the clothing have been carried into the wound with the bullet, while the condition of contusion about the margins of the wound renders sloughing very probable.

While the bullets fired from the old guns were frequently deflected by bone or tendons after entering the tissues, this rarely happens with modern firearms. Owing to their greater velocity, bone is penetrated with ease. Modern bullets, however, pro-



FIG. 160.—Upper end of tibia penetrated by bullet, showing clean-cut wound without laceration of bone (La Garde).

duce less damage when they do penetrate bone than did the old-style bullet. The former simply produce a small, clean hole, whereas the latter caused great damage, frequently producing an extensive splintering and bad comminuted fractures.

Wounds from small shot vary as to severity according to the ranges from which they are fired. At long range they rarely do more than penetrate the skin; at close range they enter the body as a solid mass causing a destruction of tissues

which is often irreparable. Single shot are easily deflected and rarely penetrate bone.

Wounds from large shot or shell are characterized by an extensive tearing of the tissues.

Gunshot wounds are accompanied by the usual symptoms of other wounds. Pain is generally slight and at first may not be noticed at all. Hemorrhage may be profuse at first, but

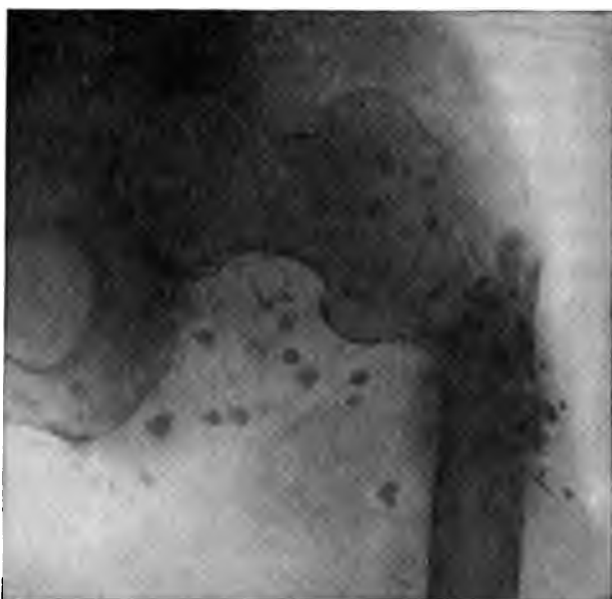


FIG. 161.—X-ray showing the effect of bird-shot. (Kindness of Dr. G. D. Stewart.)

usually ceases spontaneously unless some large vessel is divided. Shock is generally present, especially if there is much laceration of tissues. Secondary hemorrhage is very liable to occur on account of the contusion of vessels and subsequent sloughing.

**Treatment.**—The immediate treatment of gunshot wounds consists first in arresting hemorrhage. Having done this, thoroughly cleanse the wound by washing with soap and water and then with a 1:1000 solution of bichloride of mercury (one

7 1/2-grain tablet of bichloride of mercury to a pint of water) and apply a temporary dressing of sterile gauze or of cotton, linen, or lint which has been boiled for five minutes and bandage the wound firmly, then immobilize the part by the use of a sling or splints and have the patient removed to a hospital, or put under the care of a surgeon for proper treatment. In the absence of medical assistance, *never probe a bullet wound*, as nothing is to be gained by such a procedure, and much damage may be done by carrying infective material into the wound.

In wounds from small shot where the pellets are simply imbedded in the skin, clean the skin thoroughly and remove the shot by picking them out with the point of a knife, *previously sterilized by boiling*. If they are in the deeper tissues it is best to leave them alone, unless they give trouble. Extensive wounds of the extremities from small shot or shell, producing severe injury to the tissue and bones, usually require amputation of the part.

**Wounds from Toy Pistols.**—These injuries are unfortunately of quite common occurrence as the result of the explosion of cheap pistols and revolvers. Any number of these wounds are met with in enthusiastic small boys around the Fourth of July. They are especially dangerous from the fact that they are usually dirty, and lockjaw (tetanus) is very liable to follow.

**Treatment.**—*Send for surgical aid promptly.* In the meantime thoroughly cleanse the wound by washing it with soap and water, followed by a 1:1000 solution of bichloride of mercury (one 7 1/2-grain tablet of bichloride of mercury dissolved in a pint of warm water), and apply a dressing of sterile gauze.

*If the services of a physician are not available*, cleanse the wound *very thoroughly* and examine it closely for the presence of any foreign bodies. Portions of wadding will sometimes be driven into the tissue quite a distance and can only be removed by cutting away the skin. Then wash out the wound with peroxide of hydrogen, if it can be obtained, or, in its

absence, with tincture of iodine or with a 1:1000 solution of bichloride of mercury (one 7 1/2-grain tablet of bichloride of mercury dissolved in a pint of warm water), and apply an antiseptic dressing.

**Powder Burns** are due to the explosion of gunpowder or fireworks. They simply consist of particles of powder which have been driven into the skin, giving it a blackened appearance. They are dangerous if situated about the face, as they may cause injury to the eyes.

**Treatment.**—Wash the skin clean and pick out all the particles of powder with a needle or sharp-pointed knife sterilized by boiling. Then apply a clean dressing to the part.

**Arrow Wounds** are rarely seen in civilized countries. They are apt to be dangerous as the shaft of the arrow frequently breaks off, the arrow point remaining imbedded in the tissues.

**Treatment.**—If possible, remove by gently pulling on the arrow; or, when near the surface, it may be pushed on out through the sound skin. Failing in these measures, enlarge the opening in the skin sufficiently to permit the arrow to be withdrawn. Afterward wash out the wound thoroughly with a 1:1000 solution of bichloride of mercury (one 7 1/2-grain tablet of bichloride of mercury dissolved in a pint of warm water), and dress antiseptically.

**Wounds from Fish-hooks.**—While the wound itself is not serious, it is a painful injury, and some difficulty may be experienced in removing the hook. The best way to accomplish this is to press the hook on out through the tissues until the barbed end is in view, when it may be cut or broken off, and the hook withdrawn.

**Sword Wounds** are generally of the nature of incised or punctured wounds and should be treated upon the principles already laid down.

**Bayonet Wounds** are to be treated as any punctured wound. They are dangerous, from the liability to infection.

**Poisoned Wounds** are those in which some poison is introduced into the tissues at the time the injury is inflicted. Dis-

secting wounds, stings of insects, snake bites, and the bites of rabid animals come under this head.

(1) **Dissecting Wounds** are met with in butchers, surgeons, and those who perform post-mortem examinations. The poison usually enters through some cut or abrasion in the skin, and, if the individual is in poor health, such a wound is likely to be followed by serious complications.

**Treatment.**—As soon as inflicted the wound should be washed and then sucked or squeezed to get rid of the poison. Shut the wound off from the general circulation by tying about the injured part, *between the wound and the heart*, a tight ligature, which should be loosened at intervals; then thoroughly cleanse and apply iodine to the wound or, in its absence, a 1:1000 solution of bichloride of mercury (one 7 1/2-grain tablet of bichloride of mercury to one pint of warm water).

(2) **Insect Bites.**—The stings of mosquitoes, fleas, wood ticks, ants, bees, wasps, hornets, and yellow-jackets seldom produce any serious trouble, aside from the immediate pain and swelling. The bites of spiders, centipedes, tarantulas, and scorpions are more serious and have been known to result in death. Dangerous symptoms appear very quickly and are manifested by vomiting, purging, great prostration, and delirium. Death occurs from heart failure.

**Treatment.**—Ordinary insect bites require but little treatment. Sometimes the sting of a bee is broken off and remains in the skin; so always search for it and remove, if present. As the poison of insects is composed chiefly of an acid (formic acid), the local application of some alkali should be employed. Water of ammonia or a solution of washing soda affords great relief. Wet earth or a fresh slice of onion may also be used.

Bites of the more poisonous spiders and insects require prompt treatment. Tie a ligature or tourniquet about the injured part *between the wound and the heart* and suck the wound to produce bleeding. Then enlarge the bite with an incision and rub into the wound crystals of permanganate of

potash or swab out with pure carbolic acid or tincture of iodine applied by means of cotton wrapped on a probe or sharpened stick. Should dangerous symptoms appear, stimulate the patient freely with whiskey.

(3) **Snake Bites.**—The poisonous snakes of the United States are the water moccasin, copperhead, rattlesnake, harlequin, and coral snake; in Europe the adder and viper; in India the krait and cobra; in the West Indies the fer-de-lance; and in Venezuela the bushmaster. Besides these, there are many poisonous lizards, the gila monster being the only one to be feared in the United States.

The poison of these reptiles is secreted by a pair of glands situated on either side of the upper jaw. At the moment the bite is inflicted the poison is discharged through the hollow fangs by means of contractions of muscles acting on the poison bag. Ordinarily the fangs lie in the hollow of the mouth and are only brought into an erect position when the animal strikes its victim.

The venom of snakes differs somewhat in its composition, and its toxic power thus varies according to the species. The poisonous constituents are neurotoxin, a substance that attacks the cells of the nervous system, and hemorrhagin which injures the lining of the blood-vessels so that an escape of blood occurs into the surrounding tissues. A third constituent, but of less importance, is hemolysin which exerts a destructive action on the blood-corpuscles. According to whether the neurotoxin or hemorrhagin predominates in the venom assigns a poisonous snake to one of two classes. The first class are spoken of as Colubrines, and their venom is made up principally of neurotoxin; the others, Viperines, possess hemorrhagin as the chief constituent of their poison.

**Symptoms.**—These will vary according to the species of snake producing the injury.

1. *Poisoning by Colubrines (the Cobra being an Example).*—The local symptoms are not marked, though there is at times severe pain and some tenderness, swelling and discoloration at

the seat of the bite. Then in  $1\frac{1}{2}$  to  $2\frac{1}{2}$  hours the patient begins to feel tired or drowsy, there often being some nausea and vomiting. Following this, paralysis sets in, generally affecting the extremities first, and then becoming more generalized, finally affecting respiration, so that patient's breathing becomes slow and shallow and finally ceases. Convulsions may also be present.

2. *Poisoning by Viperines (of which the Rattlesnake is a Type).*—Following such a bite, there is pain at the seat of injury which soon becomes excruciating, rapid swelling, and discoloration. The part takes on a purplish hue. There is at the same time a feeling of nausea and faintness, while a sense of depression takes hold of the individual. The pulse becomes rapid and feeble, and the breathing is labored. In fatal cases death may occur within twenty-four to forty-eight hours.

**Treatment** must be instituted promptly. If the injury be upon an extremity, prevent any further spread of the poison by placing a tight ligature or a tourniquet about the part *between the wound and the heart*; encourage bleeding and the escape of the poison by sucking the wound, *provided, however, there are no cuts or abrasions upon the lips*. A ligature should not be put on tightly and left for any length of time, as this will entirely cut off the circulation to the part; it is better to loosen and tighten it at intervals, thereby letting only small quantities of the poison into the system at a time. Further treatment consists in injecting a 1 per cent. solution of permanganate of potash into the tissues surrounding the bite, or the pure crystals of the drug may be rubbed into the wound after it has been freely incised. If this treatment is not possible, the wound should be cauterized. This may be done by means of a hot iron or a piece of a hot coal; gunpowder placed in a wound and ignited will also thoroughly cauterize it. If constitutional symptoms appear, whiskey should be given in liberal quantities, and heart stimulants, if to be had, should be used.

Calmette's serum, or antivenene, has been employed with success in the treatment of cobra bites, but it is of doubtful



value in rattlesnake poisoning. Lately, however, Flexner and Noguchi have produced an antivenin for the latter.

(4) **Bites of Animals**, unless the animal is afflicted with hydrophobia, are not serious, but the wounds may become infected and cause considerable trouble.

Hydrophobia, or *rabies*, is the result of an infection of the system through a wound with the virus of a rabid animal. The disease is usually communicated to man by dogs, but cats, wolves, foxes, and horses are equally dangerous when affected.

In man the incubation period is usually from twenty days to two months, but it may be anywhere from fifteen days to six months; in dogs it is from three to five weeks. It is said that about 14 per cent. of those bitten by rabid animals develop the disease. If bitten through the clothing, there is less danger of inoculation than if the bite is on an exposed part of the body.

When a person has been bitten by an animal supposed to have hydrophobia, but where there is some doubt, the animal should not be killed, but should be *confined* and carefully watched for a couple of weeks. If the dog lives and remains well at the end of this period, there need be no fear that he was suffering from rabies. If he should die, the body should be sent to a competent pathologist for examination.

**Treatment.**—The immediate treatment of the wound consists in destroying the poison and preventing its escape into the system. If the injury be upon an extremity, place a ligature or tourniquet about the part *between the wound and the heart* and thoroughly cleanse the wound, washing first with soap and hot water and then with a 1 : 1000 solution of bichloride of mercury (one 7 1/2-grain tablet of bichloride of mercury in a pint of warm water). Finally swab out the wound with pure carbolic acid applied by means of a cotton wrapped stick, or thoroughly cauterize the wound with a hot iron or hot coal. If this is not possible, simply excise the whole wound with a sharp knife and dress antiseptically. Finally, *have the patient removed to a Pasteur institute for preventive treatment.*

**WOUNDS OF THE CHEST AND ABDOMEN.**

Wounds in the cavities of the body are spoken of as *non-penetrating* when they do not extend entirely through the wall of the cavity; *penetrating*, where they enter a cavity; and *perforating*, when they penetrate and produce some injury to the viscera within. These injuries are usually the result of stab or gunshot wounds. Perforating wounds are most serious injuries, because they may be accompanied by wounding of the heart, lungs, intestines, or some of the other abdominal viscera, and frequently by injuries to some of the great vessels, which cause a fatal hemorrhage.

Injury to the heart and pericardium, if not immediately fatal, produces severe shock and internal hemorrhage.

Wounds of the lungs are manifested by pain, coughing, difficult breathing, and spitting up of blood and bloody mucus. There may also be a hissing sound of air escaping through the wound with each respiration.

Injury to the abdominal viscera is usually accompanied by considerable shock. Pain is severe and stabbing in character, there is a profuse internal hemorrhage, and the patient goes into a state of collapse. Wounds of the abdomen, even though moderate in extent, are liable to be followed by protrusion of the intestines. Gas, bile, and partly digested food frequently escape from the wound, depending upon the parts injured.

**Treatment.**—*Always send for surgical aid promptly.* In the meantime, unfortunately, but little can be done except to clean and cover the wound with a clean compress or pad. Endeavor to keep the patient quiet and free from excitement. If the intestines or other viscera are protruding, they should be washed off in warm boiled water, or salt and water, (1 teaspoonful of salt to a pint of boiled water) and replaced if uninjured; otherwise, endeavor to keep them warm and protected from the air until surgical aid arrives by wrapping them in cloths wrung out in hot salt water and frequently changed. Treat the shock by external heat applied to the heart and extremities.

## CHAPTER XV.

### BURNS, SCALDS, AND EXPOSURE TO COLD.

#### BURNS AND SCALDS.

A *burn* is an injury or destruction of the skin or deeper tissues caused by dry heat, heated substances, or chemical agents.

A *scald* is the same kind of an injury, but differs from a burn in being produced by hot vapors or hot liquids.

Burns and scalds so closely resemble each other that they will be considered together. A scald, being caused by liquids and substances which are easily diffused over a large area, usually covers more surface and is apt to be more superficial than a burn. The hair on a scalded surface usually remains uninjured, while in a burn it is scorched or completely burned off. Extensive burns or scalds, even when superficial, are dangerous; and, if one-half of the surface of the body is so injured, a fatal result is to be expected, even superficial burns involving one-third of the body often terminate fatally.

The pain following a burn or scald is intense and is increased by exposure of the part to the air. Shock is present to a more or less marked degree in all burns, the early fatal cases usually terminating from shock within twenty-four hours. Extensive burns cause a congestion of the internal organs, and frequently the congestion is so intense that the sufferer shivers and complains of being cold. Should a patient survive the immediate shock and react, he is liable to die later from congestion of the kidneys, lungs, or brain.

**Classification of Burns.**—Burns are divided, according to the amount of tissue destroyed, into three degrees.

(1) A *burn of the first degree* is where simple redness or inflammation of the skin is produced.

(2) *A burn of the second degree* is where there is inflammation of the skin accompanied by blebs or vesicles.

(3) *A burn of the third degree* is where there is a charring and destruction of the skin and deeper tissues.

**Treatment.**—In removing the clothing from the body of a badly burned person, care should be taken not to injure the blebs. The clothing is very apt to stick to the injured surfaces, and so should be cut or ripped up the seams, the portions which remain fast being softened with oil or warm water and then carefully removed.

For burns of the first degree a saturated solution of bicarbonate of soda or the common remedy carron oil (composed of equal parts of linseed oil and lime water), poured on lint, makes a soothing dressing. Vaseline, lard, cosmoline, boric acid ointment, zinc oxide ointment, olive oil, and castor oil, or even white lead paint may be used if nothing better is at hand.

In burns of the second and third degree, aside from the severity of the injury itself, one is impressed with the excessive amount of pain and severe shock which are usually present; and these symptoms should be *promptly treated*, the pain being controlled by the use of morphine. Any of the dressings recommended for burns of the first degree may be used; but, where there is much destruction of tissues or sloughing, a weak antiseptic dressing acts better. All the blebs should be punctured with a needle or sharp-pointed knife which has been boiled, and the serum allowed to escape; but the skin of which these blebs are composed should not be removed, as it forms a protection from the air for the parts beneath. In dressing extensive burns care must be taken not to expose a large surface to the air at once. To avoid this it is well to apply the dressings in small sections, so portions may be removed and reapplied without disturbing the whole dressing. All sloughs and dead tissue should be cut away at each dressing.

**To Extinguish Flames from a Person's Clothing.**—It may be well to say here a few words about what to do when a person's clothing catches fire. It should be remembered that

flames invariably rise upward; hence, if a person whose clothes are afire lies flat upon the floor or ground there will less fuel for the flames and less surface of the body exposed than in the upright position. Most people forget this or become confused and panic-stricken and rush wildly about and, by so doing, simply furnish an added draught for the flames. Do not get



FIG. 162. —Proper method of throwing a blanket upon a person whose clothes are on fire.

excited yourself, but instruct the sufferer to lie down flat, or even throw him down, if necessary, and quickly envelop the whole body with a blanket, rug, tablecloth, or coat, and attempt to smother the flames. In doing this, care should be taken to stand at the sufferer's head and, holding down with the foot one edge of the blanket or whatever is used, to throw it away from yourself and *toward the feet of the individual* (Fig. 162); the

flames are thus swept away from the rescuer and from the face of the burning person. Through carelessness in this matter the flames are liable to be swept back and set fire to the clothes of the rescuer, especially if such a person be a woman with skirts.

**Burns from Acids** are generally caused by concentrated nitric, hydrochloric, or sulphuric acid. They are frequently the result of acid-throwing assaults.

**Treatment.**—Neutralize the acid with some alkali, using for this purpose lime-water, a solution of washing soda, soap, or chalk; then treat as any burn (see page 213). If the eyes are injured, wash them out with a weak solution of bicarbonate of soda and apply a few drops of oil between the lids.

**Burns from Alkalies** are usually produced by caustic soda, caustic potash, or lime.

**Treatment.**—Neutralize with some weak acid, as vinegar or lemon juice, and treat as you would an ordinary burn (see page 213).

**Brush Burn** is a form of injury produced by friction. It is often caused by a rope rapidly passing through the hands, and is similar to a burn in appearance.

**Treatment.**—Clean the wounded surface and dress antiseptically; or treat as a burn (see page 213).

**Burns from Electricity and Lightning.**—If the current is strong death usually occurs instantly, being due either to the effect of the current on the heart or to asphyxia from a paralysis of respiration. In other cases the patient may simply be rendered unconscious and severely burned. The burns themselves are very severe, as they are followed by an extensive sloughing and destruction of tissues, and heal very slowly.

Great caution should be observed in approaching a person who has received an electric shock and is still in contact with the current. *Do not touch the body until the current has been turned off unless you are provided with rubber gloves*, as such a procedure would result in the rescuer receiving the full force of the current. If rubber gloves are not available, *heavy woolen gloves* may be substituted or the hands of the rescuer may be

wrapped in a silk scarf or a silk petticoat. In removing the person from the reach of the current care must be taken to grasp portions of the patient's clothing that are dry and not to touch metallic buttons, metal portions of suspenders and belts, etc.; it is also important to avoid standing in puddles of water or on wet ground.

**Treatment.**—*Send for medical aid immediately.* In the meantime apply external heat to the heart and extremities by means of hot-water bags or hot bottles (page 162), and, if the respirations are labored or have ceased, employ artificial respiration, as described on page 263, being careful to keep the tongue well forward while this is being done. The burns may be treated as any ordinary burn (see page 213).

**Sunburn.**—In some individuals exposure to the sun produces great redness of the skin and marked pain—a condition similar to a burn of the first degree or even of the second degree. If a large area of the body is involved, the condition is sometimes serious and death may ensue.

**Treatment.**—Apply any of the soothing applications recommended for burns of the first degree (page 213).

#### EXPOSURE TO COLD.

Prolonged exposure to extreme cold results in a general depression or lowering of the vitality, a gradual chilling of the body, and a congestion of the internal organs. The body and limbs first feel numb and heavy, and then become stiff; drowsiness and an irresistible desire to sleep take hold of the sufferer. If left alone, unconsciousness and death rapidly follow.

**Frost-bite** is an actual freezing of a part by intense cold. Generally the ears, nose, or extremities are affected. The parts first look red or blue, and then become pale or mottled. Their vitality may be so completely destroyed at the time that later gangrene sets in.

**Treatment.**—In treating a frost-bitten or frozen person avoid above all things the use of heat to the body, and be careful to bring about reaction slowly. Bringing a frozen person sud-

denly into a warm room may result fatally. The proper thing to do is to place the sufferer in a cold atmosphere, *i. e.*, at a temperature of 34° to 35° F., and gently rub the body with ice, snow, or cold water, supplying friction with the hands or a towel until the circulation is reëstablished. Then, as the patient reacts, he may be gradually covered with blankets and removed to a warmer room.

The later treatment consists in the use of stimulants and proper nourishment, which may have to be given by the rectum (see page 167). Should gangrene of a frost-bitten part occur, amputation will in all probability be necessary.

**Chilblains** are chronic inflammatory swellings of the skin, usually seen in the face, ears, nose, or extremities, the result of congestion following exposure to cold, or they may be produced by the too rapid application of warmth to a frozen part. The warmth produces a dilatation of the blood-vessels and consequently the blood, which has been driven from the part by the intense cold, returns in an excessive amount.

Swelling and local congestion occur, followed by an intense itching and burning sensation in the part with the formation of blebs. These symptoms usually disappear in a day or two, but, if the part is again exposed to cold followed by a sudden change in the temperature, the condition may become permanent and be felt after any exposure to even slight cold. A person once frozen or frost-bitten is very liable to suffer from chilblains.

**Treatment.**—As a preventive against chilblains always be careful to restore the circulation in a frozen part gradually. A person susceptible to this condition should avoid remaining close to a hot fire in cold weather and, when going out in the cold, should wear warm clothing and avoid tight shoes or gloves. The actual treatment of the condition should be left to a physician.



## CHAPTER XVI.

### FRACTURES.

This is one of the most important classes of injury we have to deal with, not only from the fact that it renders the victim a cripple for the time being, but also because so much of the future usefulness of the limb depends upon a recognition of the trouble and its proper immediate treatment. Frequently carelessness or ignorance in handling a fracture at the start renders the sufferer an invalid for life.

A fracture may be defined as a break in a bone. It may occur in any of the bones if sufficient force is applied to them, but is more liable to occur where the bones are brittle, as in certain diseased conditions, or old age. In children the bones are soft and tend to bend rather than break.

Fractures caused by blows delivered directly at the seat of injury are said to be due to *direct violence*. Fractures produced by *indirect violence* do not occur at the point at which the force is applied, but such force is transmitted and expended upon some distant part. For example, a person may fall and strike on his feet and yet receive a fracture at the hip. Fractures *from muscular action* are rare. They are produced by the violent contraction of a muscle acting suddenly on a bone. As an example, the muscular action brought into play in throwing a ball may produce a fracture of the arm.

**Varieties of Fractures.**—Fractures are classified as incomplete, complete, simple, compound, multiple, comminuted, complicated, and impacted.

*An Incomplete Fracture* is one where the bone is broken or bent, but not broken entirely through. It is also called “greenstick” fracture, and often occurs in children.

*A Complete Fracture* is one where the bone is severed through its entire thickness.

*A Simple Fracture* is one in which the bone is broken, but no communication exists between the fracture and the exterior.

*A Compound Fracture* is one in which an open wound leads from the surface of the body or mucous surface to the seat of fracture.

*A Multiple Fracture* is one where the bone is broken into more than two fragments. The lines of fracture, however, do not communicate with each other.



FIG. 163.—Green-stick fracture (Da Costa).



FIG. 164.—Complete fracture of both bones of the leg (Hoffa).

*A Complicated Fracture* is a break in the bone accompanied by an injury to some of the surrounding parts—as, for example, a joint, muscle, nerve, or blood-vessel.

*A Comminuted Fracture* is one where the bone is broken into several pieces, the lines of fracture communicating with each other.

*An Impacted Fracture* is one in which one fragment of bone is driven into the other, the two remaining tightly wedged.

**The Repair of Fractures.**—When a bone breaks there is always an injury to the periosteum and surrounding tissues and some hemorrhage about the ends of the fragments, and the space between the two fragments rapidly becomes filled with a blood-clot. A mild inflammation in the immediate neighbor-



FIG. 165.—Comminuted fracture of the tibia (Pilcher and Warbasse).



FIG. 166.—Impacted fracture of the tuberosities of the humerus (Bardenheuer).

hood of the fracture soon follows, and as a result there is a mass of new-formed tissue called *callus*. It lies between the bones, surrounds the ends of the fragments, and, as it were, glues them together. At first this callus consists only of fibrous tissue, but later there is a growth of bone cells, and a deposit of lime salts occurs which changes the callus into dense bone. A callus may be felt as a distinct knot or projection at the seat of fracture for

some time after the bone has united, but later disappears through absorption. Fractures which unite, but in which the callus remains as fibrous tissue, having failed to ossify or harden, are spoken of as having "fibrous union."

**The Signs and Symptoms of Fracture** are pain, swelling, discoloration, deformity, abnormal motion, loss of power, and crepitus.

**Pain.**—Some slight pain is always present in a fracture, and in some cases the pain may be quite severe and sharp, lasting for some time after the injury and quickly recurring upon any movement of the limb.

**Swelling and Discoloration** appear soon after the injury, their presence being due to the wounding and contusion of the soft parts.

**Deformity** of the limb is probably the most constant sign of fracture. It is partly the result of swelling and partly due to the displacement of the broken fragments. The bones become displaced from the weight of the limb and from muscular contractions acting upon them. As a result the shape of the limb is distorted, or abnormal shortening occurs. Hence, in examining a limb for fracture it is advisable to compare the limbs of both sides, as sometimes one can discover at a glance a fracture from the unusual outline of the limb.

**Abnormal Mobility** is a positive sign of fracture and consists in motion obtained at points in a limb where normally if the bones were not broken no movement could possibly occur. In impacted fractures this sign will be absent.



FIG. 167.—Callus of fracture (dog) four weeks; commencing ossification of external callus (Warren).

**Loss of Power** consists in an inability of the patient to move the limb.

**Crepitus** is the harsh grating which may be felt and, at times, heard when the two ends of a broken bone are moved upon one another. It is a sign sometimes elicited during examination of a broken limb, *but should never be sought for.*

**Examination of a Limb for Fracture.**—When examining a limb supposed to be fractured, much may be learned by

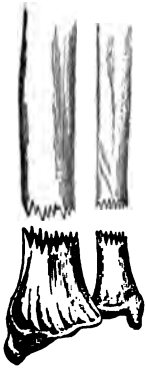


FIG. 168.—Appearance of the ends of fragments (Da Costa).

closely questioning the patient as to how he received his injury, whether he was able to use the limb after being hurt, etc. Often it will not be necessary to remove the clothing to discover the injury, as the distorted shape of the limb and the pain caused by touching or moving the part are sufficient to make us reasonably sure of the trouble; or the sufferer himself may make a diagnosis, saying he felt something give way or heard a bone snap.

Begin the examination of the limb by first passing the fingers down the bone supposed to be injured, using moderate pressure, and at some point there will be discovered an area of increased tenderness. Then gently move the limb and ascertain if there is any false point of motion, but do not try to produce crepitus. If still in doubt, compare the limbs of both sides as to shape and length and, if necessary, measure them, taking the measurements between some prominent bony points. In making this examination always remember to disturb the part as little as possible and to use the greatest care and gentleness. On no account lift a broken limb without supporting it by a hand placed beneath each fragment.

*When there is any doubt at all as to whether a limb is broken, it is safer to treat it as such until examined by a surgeon.*

**The Immediate Treatment of a Simple Fracture.**—If we consider that the ends of a broken bone are usually sharp

and irregular, it can readily be seen how easy it is by carelessness in moving a patient or by rough handling of a broken limb to cause these sharp fragments to protrude through the tissues and skin, thus converting what was at first a comparatively simple injury into one which is exceedingly grave and may result in the loss of the limb. Even the slightest movements of a broken limb, while they may not go so far as to convert a simple into a compound fracture, may cause an injury to the surrounding tissues, nerves, or blood-vessels



FIG. 169.—Treatment of a fracture of the leg without splints.

which is irreparable. For this reason never allow a broken limb to hang dangling or to become twisted.

The immediate treatment, then, should consist in so immobilizing the parts by the application of splints that any further injury is prevented. This must be done upon the spot. *Never allow a person suffering from a broken limb to be moved until the part is properly splinted.*

**Splints.**—In an emergency any material which has sufficient firmness to give support to a limb will answer for splints. Umbrellas, canes, swords, guns, golf clubs, cigar boxes, firewood, wire, leather, laths, bed-slats, barrel staves, several thicknesses of a newspaper, pillows, or a folded coat may be used. In the country twigs, bark, branches of trees, bundles of straw or hay, cornstalks, or a short fence-rail may be utilized. For permanent splints some soft pine or other wood about one-quarter to one-half inch thick and three to four inches wide

should be procured, the length depending on that of the limb we wish to confine. As a general rule splints should be long enough to confine the joint above and the one below the seat of fracture and should be somewhat broader than the limb itself. More elaborate splints are made from tin, plaster-of-Paris, felt, or binders' board. In fracture of the leg or thigh, if no splints can be obtained, the broken limb may be immobilized by tying it to the sound limb, the latter then acting as a splint (Fig. 169).



FIG. 170.—Temporary splints applied to the arm.

**The Application of Splints.**—Splints may be applied temporarily over the clothing and should always be *well padded*, as a hard board against an injured limb soon becomes very painful. Oakum, cotton, grass, moss, portions of clothing, or any soft material will answer for the padding. If possible, two splints should be applied to a limb; while in fractures of the leg three are generally used, one on each side and one behind. In applying splints have an assistant hold them

in position, and then firmly fasten them to the limb by several turns of a roller bandage, adhesive strips, handkerchiefs, pieces of rope, or portions of clothing. Before applying the splints, any deformity of the limb should be reduced by gentle traction, when the limb will usually assume its natural shape.

Having provided a temporary support for the broken limb, the patient may be removed to a hospital or his home, where he can receive proper surgical attention. *On no account allow a person suffering from a fracture of the lower extremity to walk, even if splints are applied.* Always provide a stretcher or some other means of conveyance.

**The Treatment of a Compound Fracture.**—To properly treat a compound fracture the clothing about the injured part should be removed. Always remove the clothing very carefully, from the uninjured limb first and then from the broken limb, cutting the clothing away if necessary. If trouble is taken to cut along the seams but little damage is done to the garments, and they may be sewed up later, but do not hesitate to destroy a garment if in so doing the sufferer can be saved unnecessary pain.

Sufficient has already been said about the dangers of a compound fracture to act as a warning. *Never touch such a fracture unless the hands are absolutely clean.* If medical aid is near at hand, the immediate treatment should consist in controlling any bleeding, placing a sterile or antiseptic pad over the wound without removing the blood-clots, and immobilizing the limb by splints.

*If surgical aid is not at hand or cannot be obtained for several days, such fractures will require much more thorough treatment than outlined above.* Remember that the whole future usefulness of the limb may depend upon the first treatment, so the greatest cleanliness should be observed in order to prevent any infection of the part. The operator first thoroughly cleanses his hands by scrubbing in hot water and soap with a scrubbing brush for five minutes. The skin surrounding the wound is next carefully shaved and thoroughly but



*gently* washed with soap and warm water. Finally carefully wash out the wound with bits of cotton boiled and then soaked in a 1:1000 solution of bichloride of mercury (one 7 1/2-grain tablet of bichloride of mercury to a pint of boiled water), care being taken to remove from the wound any foreign bodies, such as particles of dirt, pieces of clothing, etc. If the bones project from the wound, they should be thoroughly washed off with a 1:1000 solution of bichloride of mercury (one 7 1/2-grain tablet of bichloride of mercury dissolved in a pint of boiled water) and replaced. Slight traction upon the limb will generally suffice to accomplish this. Then place a small strip of sterile gauze in the wound as a drain, and finally apply an antiseptic dressing and properly support the part with splints. The drain may be removed after an interval of several days.



FIG. 171.—Comminuted fracture of the skull (Hoffa).

#### FRACTURES OF SPECIAL BONES.

**Fracture of the Skull** may occur in the vault or base. Fractures of the vault are the result of blows or falls upon the head. Fractures of the base are caused by indirect violence the result of falls upon the feet or blows upon the jaw.

Symptoms of concussion and compression of the brain

usually accompany a fracture of the skull (see Concussion and Compression, pages 276 and 277), as there is always more or less severe injury to the brain substance, and frequently compression from blood or bone results. The person, as a rule, is unconscious. In fracture of the base there may be bleeding from the ears or nose and an escape of cerebrospinal fluid from the ears. Later, a subcutaneous hemorrhage (ecchymosis) develops about the eyes.

**Treatment.**—*Send for surgical aid.* In the meantime dress any wound upon the head with an antiseptic pad or clean compress. Have the patient removed to a cool room and kept as quiet as possible, with ice applied to the head by means of an ice bag (page 161). If shock is present, heat should be applied to the heart and extremities, *but avoid stimulants.*

**Fracture of the Nose** is the result of direct violence applied to that region. There may be no external sign of the injury; or there may be considerable swelling and deformity, the bones being flattened or pushed to one side and capable of being easily moved by manipulation. If the bones be grasped between the thumb and forefinger and be moved gently from side to side, abnormal motion and crepitus will be elicited. The injury is usually accompanied by a profuse hemorrhage from the nose.

**Treatment.**—Return the bones to their normal position, if possible, by *gentle* manipulations. To retain them in position we may employ two very small rolls of narrow bandage, held upon each side of the nose by strips of adhesive plaster (Fig. 172). Little else in the way of treatment is required except to keep the nose clean; if there is much bleeding, the nostrils may have to be packed. (See Bleeding from the Nose, page 190.)



FIG. 172.—Fracture of the nose dressed with two small bandages and adhesive strips.



FIG. 173.—Fracture of body of the lower jaw, showing loss of alinement of teeth (Scudder).

**Fracture of the Lower Jaw** is quite a common accident, and may be caused by falls, blows, kicks upon the chin or sides of the face, or even by rough extraction of a tooth. This injury is usually compound, the mucous membrane of the mouth being torn so that there is a wound leading from the cavity of the mouth to the seat of fracture.

Infection is thus very liable to follow through the entrance of food and bacteria. Fractures may occur at any point in the bone, but the usual seat is through the body of the jaw.

Deformity is manifested by an unevenness in the line of the teeth. There is an inability on the part of the sufferer to talk clearly, and dribbling of saliva and



FIG. 174.—Treatment of fracture of the jaw by means of a four-tailed bandage.

blood occurs from the mouth. Pain is present to a marked degree.

**Treatment.**—The greatest difficulty may be met with in keeping the broken fragments in position. Get them in as good position as possible, however, and hold them there by means of a four-tailed bandage (page 144), Barton's bandage (page 120), or Gibson's bandage (page 121). Above all, see that the mouth is kept clean, using for this purpose a saturated solution of boric acid (five teaspoonfuls of boric acid to a pint of water) or some good mouth wash, such as listerin one part and water two parts. The patient should later consult a surgeon, as it is often necessary to have an interdental splint made so that the broken fragments may be held in proper position.



FIG. 175.—Partial fracture of twelfth dorsal and fracture of first lumbar vertebrae (Warren Museum, specimen 941).

#### **Fractures of the**

**Spine** are comparatively rare and are usually accompanied by the dislocation of a vertebra. The injury may be the result of either direct or indirect violence. As a rule the fracture of a vertebra is accompanied by more or less injury to the spinal cord, resulting in paralysis of the extremities and loss of sensation. The local symptoms of pain and deformity are also present. The deformity can usually be discovered by passing the fingers lightly down the spine.

**Treatment.**—Very little can be done in the absence of surgical assistance. The patient should be kept quiet, lying flat on the back. If it is necessary to move him, it should be done with extreme care to prevent any additional injury to the spinal cord. Shock should be treated by the application of heat to the extremities (see page 280).

**Fracture of the Ribs** may be produced by blows, falls upon some sharp object, crushing forces, and by heavy bodies pass-



FIG. 176.—Fracture of the ribs. Starting the application of the adhesive-plaster swathe to encircle the trunk (Scudder).

ing over the chest. Muscular action is also said to be a cause. The usual location for the fracture is between the fifth and ninth ribs. These fractures are frequently accompanied by wounding of the pleura or lung, and pleurisy or pneumonia is in such cases apt to be a sequel.

The symptoms are pain or a “stitch” in the side and some difficulty in breathing. Pain is especially severe if the patient coughs or sneezes. With extensive injury to the lung substance there may be spitting up of blood and an escape of air beneath

the tissues of the chest, a condition called emphysema. It is easily recognized by the sharp crackling sensation imparted to the fingers.

On examination, by passing the fingers along each rib in succession, one will be able to elicit a local point of tenderness and often a false point of motion or grating in one or more of them. By placing the ear against the injured side and asking



FIG. 177.—Fracture of the ribs. Finishing the application of the adhesive-plaster swathe to the trunk (Scudder).

the patient to take a deep breath, grating may be distinctly heard.

**Treatment.**—The main thing is to prevent any possible injury to the lung and to afford some relief from the pain. This can only be accomplished by immobilizing the injured side.

As a temporary dressing a broad binder of muslin, a many-tailed bandage, a triangular bandage, a cravat bandage, or an ordinary roller bandage, applied firmly around the chest, will afford much relief.

Strapping the chest, however, is the best treatment, both in

emergencies and as a later treatment. Procure a strip of plaster wide enough to cover the injured side, say eight or nine inches wide, and long enough to extend from the spine behind to just beyond the median line in front, and apply as follows: With the patient standing up with arms above his head, tell him to "let out all his breath," and as he does this, quickly apply the plaster to the injured side of the chest as shown in Figs. 176 and 177. The plaster is applied at the end of a forced

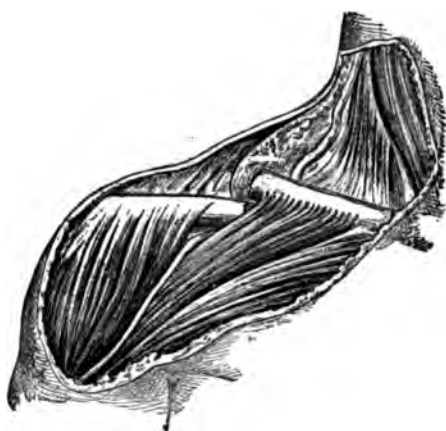


FIG. 178.—Fracture of the middle portion of the clavicle (Anger).

expiration because at this time, the lungs being nearly empty and the chest wall relaxed, the broken fragments are more nearly in apposition.

In place of a single strip of plaster, several strips, each about two and a half inches wide, may be applied, beginning well below the fracture and gradually working up. Apply each strip with even firmness, allowing it to overlap one-third of the one below (see Fig. 125).

When there is injury to the lungs accompanied by spitting up of blood, in the absence of medical assistance, keep the patient quiet in bed and give cracked ice by mouth.

**Fracture of the Clavicle, or Collar Bone.**—The collar-bone is said to be injured the most frequently of all bones.

It is a common injury in children. The fracture may be caused by direct violence or by indirect violence from falls upon the hand, and may be located in any portion of the bone, but the usual seat is at the junction of the outer and the middle third.

The weight of the arm drags down the outer fragment and produces a well-marked deformity; the shoulder drops downward, forward, and inward, and the patient will usually support the arm with the uninjured hand. There



FIG. 179.—Treatment of a fractured clavicle with a large arm-sling.



FIG. 180.—Fracture of the clavicle dressed with a four-tailed bandage.

is considerable pain and an inability to use the arm. Examination of the bone will reveal the deformity and irregularity of its outline, while upon manipulation a false point of motion can readily be obtained.

**Treatment.**—As an emergency dressing, a large arm-sling with a pad in the armpit and the arm bound to the side will answer (Fig. 179); or, if one is ex-



pert in bandaging, a Velpeau (page 124) or Desault bandage (page 125) may be applied.

Another excellent temporary dressing consists in a four-tailed bandage. It is applied as follows: Each end of a piece of muslin six to ten inches wide is split into two tails to within five or six inches of each other. The central part is placed under the elbow of the injured side, while the hand of the same side rests upon the opposite shoulder, a pad or towel being placed in the armpit. The two lower ends of the bandage pass up, one from behind and the other in front, to the opposite shoulder, where they are tied; the two upper tails are secured around the chest, thus fastening the arm to the side (Fig. 180).


Much the same dressing may be applied by using two cravat bandages. One supports the elbow and is fastened upon the opposite shoulder; the other secures the arm to the side of the chest.

The latter treatment, *in the absence of surgical assistance*, consists in the application of any dressing which will keep the shoulder up, back, and outward, thus holding the broken fragments in their normal position. Many forms of dressing have been devised for this purpose, the Velpeau (page 124), Desault (page 125), or Sayre (page 153) dressing being most frequently used.

Fracture of the collar-bone is sometimes treated without any dressing at all, simply having the patient lie flat on his back upon a hard bed with the arms placed across the chest and a narrow cushion between the shoulder blades. The patient is allowed to be up in from two to three weeks, the arm being supported in a sling.

**Fracture of the Scapula**, or shoulder blade, is not a very common injury. The fracture is usually caused by direct violence, and may occur in the body, the neck, the acromion process, or the coracoid process of the bone.

The usual signs and symptoms of a fracture—pain, swelling, disability, and crepitus—are present, but there may be some difficulty in locating the exact seat of injury.



**Treatment.**—Fractures through the body of the bone are best treated by a compress over the seat of injury and immobilization of the arm.

Other fractures of this bone are to be put up with a pad in the armpit and the arm supported in a large arm-sling, or else apply a Velpau (page 124) or Desault (page 125) bandage.

**Fractures of the Humerus**, or arm bone, may be caused by blows upon the arm, falls upon the hand or shoulder, and by muscular action, and may occur in any part of the bone.

A fracture in the neck of the bone may be hard to recognize. In such a case there is usually pain and discoloration about the shoulder and inability to use the arm. If the fingers be placed in the armpit and the arm be *gently* rotated and moved in all directions, it will be found that the head of the bone does not move with the shaft and crepitus may be felt near the shoulder-joint. Fracture high up in the bone may result in injury to the vessels in the armpit, so it is well to examine the pulse at the wrist in dealing with such an injury.



FIG. 181.—Fracture of the upper and lower ends of the shaft of the humerus, showing displacement (Hoffa).

Fracture of the shaft of the bone is a common injury. Pain, deformity, false point of motion, and inability to use the arm are usually all present; in addition, if the two arms are compared, it will be found that the injured one is shorter than the other. The displacement of the broken bones will vary according to the seat of fracture. In fractures of the upper third of the bone the upper fragment will be pulled inward by the chest muscles; in fracture of the middle and lower thirds the upper fragment will be pulled forward and outward, while the lower fragment



FIG. 182.—Temporary dressing for fracture of the humerus in its upper third.

will be drawn back and inward by the attached muscles (see Fig. 181).

**Treatment.**—A fracture of the neck or upper third of the bone may be put up temporarily by placing a pad or folded towel in the armpit and securing the arm to the side with a bandage. Then place a sling about the wrist (Fig. 182). With this dressing the weight of the arm and forearm

acts as an extension.

Fracture in the middle of the shaft of the bone may be treated by the use of two broad splints (Fig. 183); or, better, four narrow ones, placed about the seat of injury and secured by a bandage or strips of adhesive plaster, the wrist being supported by a sling. Care must be taken, however, that the inner splint does not extend too high in the armpit, as it



FIG. 183.—Temporary dressing for a fracture of the shaft of the humerus.

might thus compress the blood-vessels or at least be exceedingly uncomfortable for the patient.

A fracture near the elbow-joint may be dressed temporarily by simply applying a large arm-sling and securing the arm to the body (Fig. 179). Fractures in this locality are serious injuries from the liability of the joint to become stiff, so the patient should always obtain surgical advice at the earliest possible moment.

**Fractures of the Forearm** may be produced by blows or falls upon the forearm or hand, either one or both bones being broken at the same time.



FIG. 184.—Fracture of both bones of the forearm, with marked angular deformity (after Bruns).

When both bones are broken, the fracture is rarely on the same plane in each bone. The injury is easily recognized, as there is generally a well-marked deformity (Fig. 184).

When only one bone is injured, the other acts as a splint, and but little deformity will be apparent, but there is inability to use the forearm, and, on examination, tenderness and a false point of motion can be discovered at the seat of injury.

**Treatment.**—In treating fractures of the forearm the limb should be put up with the elbow bent at a right angle, the forearm across the chest, with the palm of the hand turned in and the thumb pointing upward. First reduce the deformity by gentle traction upon the hand, and then apply two well padded splints to the seat of fracture, having them long enough to extend from the elbow to below the wrist (Fig. 185); bandage



**FIG. 185.**—Treatment of a fracture of both bones of the forearm (Scudder).



**FIG. 186.**—Fracture of both bones of the forearm. Proper position of arm in sling (Scudder).

the splints or secure them firmly in place by means of strips of adhesive plaster and support the forearm by means of a sling (Fig. 186). If splints cannot be obtained, a large arm-sling (page 146) alone may be used as a temporary dressing.

**Fracture of the Wrist, Colles' Fracture.**—There is a very common fracture of the lower end of the radius, the result of falls upon the outstretched palm of the hand, known as a Colles' fracture, or the "silver-fork" fracture, deriving the latter name from the resemblance the deformity following this injury has to the shape of a fork (see Fig. 187). While a Colles' fracture may occur in the young, they are much more common in those past the age of forty.



FIG. 187.—Colles' fracture, showing the characteristic deformity (Scudder).

**Treatment.**—A Colles' fracture may also be put up temporarily in the manner described above for a fracture of the forearm (see Fig. 185), or a single well-padded splint may be applied on the back of the arm extending from below the elbow to the fingers. *The patient should always consult a surgeon for later treatment*, as, unless properly reduced and treated, the deformity is apt to be permanent.

**Fractures of the Metacarpal Bones, or hand,** may follow from falls upon the hand, but usually are the result of blows delivered with the fist. There is generally pain, swelling, and a deformity present, the latter being characterized by the projection upon the back of the hand of one of the broken fragments.

**Treatment.**—Place a compress on the back of the hand over the seat of injury, and, with a pad of oakum or cotton in the palm of the hand, apply a well-padded splint to the hand and forearm on the palmar surface. The fracture may also

be put up by placing a pad or roller bandage in the hand, over which the fingers are closed and held in place by a bandage or adhesive plaster, as shown in Fig. 188.



FIG. 188.—Fracture of the metacarpal bone of the index-finger. Adhesive-plaster straps holding hand and roller bandage in position (Scudder).

**Fracture of the Phalanges**, or fingers, is not a common injury, but is, as a rule, easy to detect.



FIG. 189.—Fracture of the finger. Wooden splint applied to the palmar surface (Scudder).

**Treatment.**—If only one finger is injured, a narrow splint should be applied to the part and secured by strips of adhesive plaster (Fig. 189). If several fingers are broken, it is better to place a pad in the palm of the hand and apply two well-padded splints, extending from below the tips of the fingers well up on the forearm.

**Fractures of the Pelvis** are rather rare, and are produced by falls or a severe crushing between heavy bodies. Such injuries are generally complicated by some injury to the internal organs and

are accompanied by more or less shock. The patient is unable to sit up or stand and complains of great pain and a sense of coming apart. With injury to the bladder, blood is passed in the urine.

**Treatment.**—When such a fracture is suspected, have the patient lie quietly on his back, apply a tight binder or bandage to the hips, and also fasten the knees together. The patient should be moved only with extreme care, using for this purpose a stretcher which is firm and will not sag; it is well to fasten the patient securely to the stretcher in order to prevent swaying or any movement of the body. Later, he should be placed upon a firm bed, with the thighs supported by pillows. If shock be present, treat by the application of heat to the heart and extremities (see page 162).

**Fractures of the Femur**, or thigh, may be due to direct or indirect violence, and may occur in the neck, shaft, or

lower extremity of the bone. Fractures of the shaft generally occur in children or young adults, while those of the neck are more common in persons past the age of fifty. This is due to the fact that in old persons the structure of the bone becomes degenerated and weakened, so that very slight injuries, as tripping and falls of a few feet, are liable to produce a fracture.

Fractures of the femur are serious injuries because there is always more or less shortening of the limb, due to the muscles contracting and pulling upon the broken fragments, which is

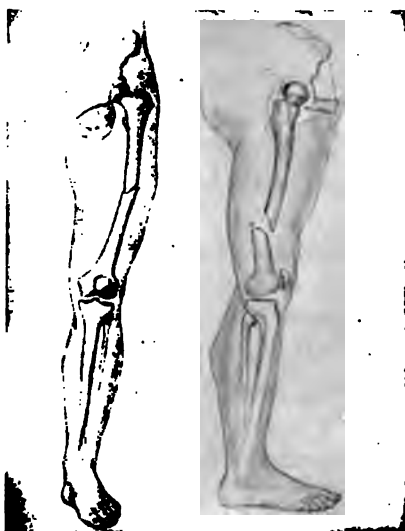


FIG. 190.—Fracture of the femur, showing the more usual deformities (Scudder).



hard to overcome and frequently results in deformity and permanent disability. The shortening of a limb after a fracture of the shaft varies from one to three inches, but in fracture of the neck of the bone it is less, usually amounting to from one-fourth to one-half inch.

At times there may be some difficulty in recognizing the injury, on account of the numerous muscles which cover the bone; but keeping in mind the following signs and symptoms will be of assistance: The patient usually lies with the toes of the injured leg pointing outward; any attempt to move the limb results in a spasm of the muscles and causes the patient excruciating pain; there is loss of power in the limb, the patient being unable to lift it. On examination, some swelling is



FIG. 191.—Fracture of hip or thigh. Emergency apparatus (Scudder).

usually present about the seat of injury, and, if the fracture be in the shaft of the bone, a false point of motion will be discovered.

The shortening of the injured limb may be estimated by having the patient lie flat on his back and measuring each limb from the anterior superior spine (the bony prominence felt above the groin) to the tip of the internal malleolus (the bony prominence above and to the inner side of the ankle-joint). This can be roughly done by using a string, if a steel tape measure is not available, and any difference in the length of the two bones will be readily appreciated.

**Treatment.**—As a temporary dressing, a long splint reaching from the armpit to below the foot should be applied—a bed-slat makes an excellent splint—but, if nothing better is at hand, a splint may be improvised from a gun-barrel or a part of a fence-paling. Pad the splint and, while traction is made upon the foot to straighten out the limb and get the bones in proper line,

apply it to the outside of the injured leg, fastening it to the waist and to the limb at different points as shown in Fig. 191. Care must be taken to bind the foot to the splint to prevent the foot from turning. Such a splint may be secured to the limb without lifting the patient from the ground by applying the splint and then simply slipping strips of bandage or adhesive plaster under the limb at intervals and securing each one separately.

The above appliance answers for emergencies and as a temporary dressing where no surgical aid can be obtained, but, a *person receiving such an injury should always be placed under the care of a surgeon as soon as possible*, as it is often necessary to give an anesthetic to properly reduce the fracture, and an apparatus will be required for a permanent dressing that will exert traction upon the limb, and so overcome the shortening.



FIG. 192.—Transverse fracture of the patella (Hoffa).



FIG. 193.—Temporary dressing for a fracture of the patella.

**Fracture of the Patella**, or knee-cap, is caused by falls or blows upon the knee and by muscular action. A person

will sometimes start to trip or fall backward, and, in attempting to recover the balance, the muscular exertion is sufficient to snap this bone.

After such an injury the patient loses control over his leg and is unable to extend it, but he may be able to stand up after once being assisted to his feet. The injury is easy to discover, as there is usually a marked separation of the two fragments, with a consequent tearing of the ligaments about the joint; the joint becomes much enlarged from the effusion of blood and serum and from the swelling of the surrounding tissues.



FIG. 194.—Fracture of both bones of leg at middle third (made from X-ray picture) (Eisen-drath).

**Treatment.**—This fracture may be treated *temporarily* as follows: Put the limb up straight, with a well-padded splint behind the leg. The two fragments of bone can be brought together by strips of adhesive plaster, one strip passing above the upper fragment and the other below the lower one in the manner shown in Fig. 193, or, in place of the adhesive plaster, a figure-of-eight bandage may be applied. The patient should be put to bed with the injured leg elevated on a pillow, and ice should be applied to the joint with the object of limiting and decreasing the swelling.

**Fracture of the Leg** may occur from direct or indirect violence, and, as in the forearm, one or both bones may be broken.

When both bones are broken there will be noticed a very apparent deformity due to the displacement of the fragments and the limb will usually be shorter than the uninjured one. On examination, abnormal motion, tenderness, and often a

grating feel will be recognized at the seat of injury. These fractures are often compound.

If only one bone is broken, the other acts as a splint and deformity will not be so marked, but there will be present the usual signs of fracture, such as discoloration of the skin, swelling, a local point of tenderness, etc.

**Treatment.**—Reduce any deformity by making *gentle* traction upon the foot in the direction of the long axis of the limb and then apply three well-padded splints—two side splints and

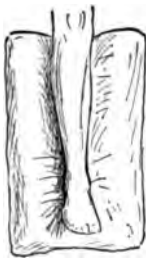


FIG. 195.



FIG. 196.

FIG. 195.—Pillow-and-side-splint. The foot is laid in a large pillow, the middle of which has been pounded down to form a hollow for the foot and leg (Cotton).

FIG. 196.—The edges of the pillow are then pinned in front, overlapped and pinned beneath the sole. Straight side-splints, with or without a straight posterior splint, are then applied and strapped tightly enough to give the necessary support (Cotton).

a posterior one—the latter to give added support and prevent a backward sagging at the seat of break. A pillow and two side splints also makes an excellent temporary dressing. It is applied as follows: a pillow, covered by a pillow case, is placed upon the ground and the injured leg is carefully laid upon it (Fig. 195). The edges of the pillow are then brought up around the foot and limb and are pinned in place. Finally two side splints are applied outside the pillow and are secured in place by straps of adhesive plaster or strips of bandage (Fig. 196).



FIG. 185.—Treatment of a fracture of both bones of the forearm (Scudder).



FIG. 186.—Fracture of both bones of the forearm. Proper position of arm in sling (Scudder).

the splints or secure them firmly in place by means of strips of adhesive plaster and support the forearm by means of a sling (Fig. 186). If splints cannot be obtained, a large arm-sling (page 146) alone may be used as a temporary dressing.

**Fracture of the Wrist, Colles' Fracture.**—There is a very common fracture of the lower end of the radius, the result of falls upon the outstretched palm of the hand, known as a Colles' fracture, or the "silver-fork" fracture, deriving the latter name from the resemblance the deformity following this injury has to the shape of a fork (see Fig. 187). While a Colles' fracture may occur in the young, they are much more common in those past the age of forty.



FIG. 187.—Colles' fracture, showing the characteristic deformity (Scudder).

**Treatment.**—A Colles' fracture may also be put up temporarily in the manner described above for a fracture of the forearm (see Fig. 185), or a single well-padded splint may be applied on the back of the arm extending from below the elbow to the fingers. *The patient should always consult a surgeon for later treatment*, as, unless properly reduced and treated, the deformity is apt to be permanent.

**Fractures of the Metacarpal Bones**, of hand, may follow from falls upon the hand, but usually are the result of blows delivered with the fist. There is generally pain, swelling, and a deformity present, the latter being characterized by the projection upon the back of the hand of one of the broken fragments.

**Treatment.**—Place a compress on the back of the hand over the seat of injury, and, with a pad of oakum or cotton in the palm of the hand, apply a well-padded splint to the hand and forearm on the palmar surface. The fracture may also

be put up by placing a pad or roller bandage in the hand, over which the fingers are closed and held in place by a bandage or adhesive plaster, as shown in Fig. 188.



FIG. 188.—Fracture of the metacarpal bone of the index-finger. Adhesive-plaster straps holding hand and roller bandage in position (Scudder).

**Fracture of the Phalanges**, or fingers, is not a common injury, but is, as a rule, easy to detect.



FIG. 189.—Fracture of the finger. Wooden splint applied to the palmar surface (Scudder).

**Treatment.**—If only one finger is injured, a narrow splint should be applied to the part and secured by strips of adhesive plaster (Fig. 189). If several fingers are broken, it is better to place a pad in the palm of the hand and apply two well-padded splints, extending from below the tips of the fingers well up on the forearm.

**Fractures of the Pelvis** are rather rare, and are produced by falls or a severe crushing between heavy bodies. Such injuries are generally complicated by some injury to the internal organs and

are accompanied by more or less shock. The patient is unable to sit up or stand and complains of great pain and a sense of coming apart. With injury to the bladder, blood is passed in the urine.

**Treatment.**—When such a fracture is suspected, have the patient lie quietly on his back, apply a tight binder or bandage to the hips, and also fasten the knees together. The patient should be moved only with extreme care, using for this purpose a stretcher which is firm and will not sag; it is well to fasten the patient securely to the stretcher in order to prevent swaying or any movement of the body. Later, he should be placed upon a firm bed, with the thighs supported by pillows. If shock be present, treat by the application of heat to the heart and extremities (see page 162).

**Fractures of the Femur**, or thigh, may be due to direct or indirect violence, and may occur in the neck, shaft, or lower extremity of the bone. Fractures of the shaft generally occur in children or young adults, while those of the neck are more common in persons past the age of fifty. This is due to the fact that in old persons the structure of the bone becomes degenerated and weakened, so that very slight injuries, as tripping and falls of a few feet, are liable to produce a fracture.

Fractures of the femur are serious injuries because there is always more or less shortening of the limb, due to the muscles contracting and pulling upon the broken fragments, which is

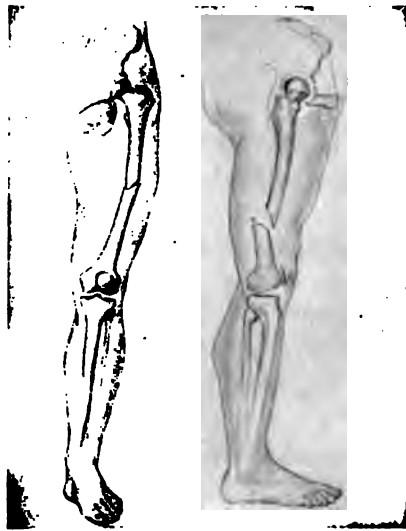


FIG. 190.—Fracture of the femur, showing the more usual deformities (Scudder).



by yawning or laughing. After such an accident the jaws are held rigid and widely opened, the lower jaw being brought forward so that the patient is unable to close the mouth (Fig. 199).



FIG. 200.—Method of reducing a dislocation of the jaw (Makins).

**Treatment.**—Summon a physician at once. *Where medical or surgical assistance is not available* have the patient sit upright in a chair and have the head held from behind by an assistant. Then place the thumbs upon the last molar teeth of each side, and, grasping the chin firmly between the fingers and thumbs, press downward and backward on the jaw, and pull upward upon the

chin (Fig. 200). This will usually result in the jaw returning to its normal position with a snap. Care must be taken that the thumbs are not bitten during this manipulation, and it is well to protect them with a bandage or towel before attempting the reduction.



FIG. 201.—Backward dislocation of first phalanx of thumb (Helferich).

After reduction is completed, retain the jaw in position by a Barton or a four-tailed bandage.

**Dislocation of the Thumb or the Fingers** usually occurs backward upon the dorsum of the hand.

**Treatment.**—Reduction of a backward dislocation of the thumb may be accomplished by bending the dislocated bone backward and at the same time making traction. With the other hand attempt to push the head of the bone into its proper position. Follow this by flexing the thumb (Fig. 202.)



FIG. 202.—Proper method of reduction of a backward dislocation of the thumb (Helferich).

Dislocations of the fingers may be reduced by strong traction on the finger, accompanied by manipulations which aim to push the head of the bone back into its proper position.

**Dislocation of the Shoulder.**—The shoulder-joint suffers from dislocation more frequently than any other joint in the body. This injury may be produced by falls or blows upon the shoulder or by falls upon the hand or elbow.

With this dislocation the arm is held rigid, the elbow stands off a distance of three to four inches from the body, and the shoulder appears flat, and there is a marked depression beneath the point of the shoulder (Fig. 203). In addition there is pain and swelling at the seat of injury.

On examination with the fingers in the injured armpit the head of the bone will be felt in an abnormal position when

compared to the uninjured side, and the patient will be unable to bring the elbow in contact with the chest when the palm of the hand of the injured side is placed upon the top of the opposite shoulder.

**Treatment.**—*When the patient can be placed under the care of a physician or surgeon within a few days of the time of accident, no attempt at reduction of the dislocation should be made by one unskilled in such work. The immediate treat-*



FIG. 203.—Subcoracoid dislocation of the humerus (Hoffa).

ment should simply consist in applying a large arm sling and binding the arm tightly to the side, being careful to insert an abundance of padding between the arm and the chest wall (see Fig. 179).

*If the patient be so situated that medical or surgical aid cannot be obtained for some time, an attempt should be made to reduce the dislocation. The simplest methods of accomplishing this is by that known as Stimson's method and by strong traction upon the arm.*

**Stimson's Method.**—The patient is placed upon a canvas

cot or stretcher, lying on the injured side with the injured arm hanging through a hole made through the cot or stretcher in the median line at a distance of about eighteen inches from the head end. In the absence of a cot or stretcher, two tables may be placed side by side and a sufficient distance apart to allow room for the arm to hang between them. Whatever the patient lies upon should be elevated from the floor upon



FIG. 204.—Stimson's method of reduction of a dislocation of the right shoulder-joint (Stimson).

blocks or chairs so that the hand does not touch the floor. A ten-pound weight is fastened to the dependent arm (Fig. 204), and, in from five to fifteen minutes, the muscles will usually have become sufficiently relaxed to allow the head of the bone to slip into its proper place of its own accord. If it should not do so, the weights should be removed and the arm brought to the patient's side against the operator's fist

held in the armpit. This will force the head of the bone back in place.

*Reduction by Traction or Extension.*—Place the patient upon his back on the floor or upon a table. Then the operator, *after taking off his shoe*, should insert the heel under the armpit and make traction upon the arm downward and slightly toward the patient's body (Fig. 205). In doing this *care*



FIG. 205.—Reduction of a dislocation of the shoulder by traction.

*must be taken not to employ too great a leverage action upon the arm as a fracture might be produced.*

Having reduced the dislocation, the subsequent treatment consists in immobilizing the arm for at least a week. This may be done by using a sling and binding the arm to the body, or by applying a Velpeau (Fig. 80) or a Desault bandage (Fig. 83) without the pad in the armpit.

**Dislocation of the Elbow.**—A great variety of dislocations occur in this joint. There may be a dislocation of one bone or of both the radius and ulna, and it may occur forward,

backward, or sideways. These dislocations are usually caused by blows upon the elbow or by falls upon the hand.

As a rule, the forearm is flexed and held rigid. When the bones are dislocated backward, there is a projection of the

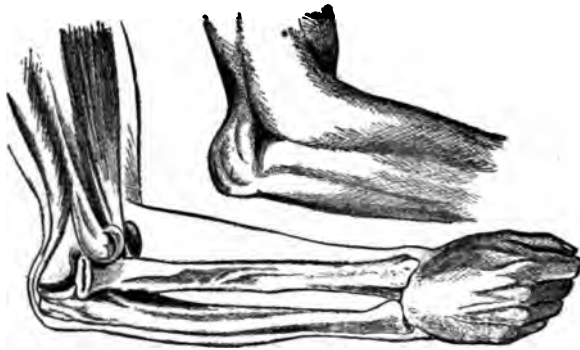


FIG. 206.—Dislocation of radius and ulna backward, showing position of the ends of the dislocated bones, deformity of elbow, and position of forearm (Hoffa).

olecranon behind the elbow and shortening of the forearm (Fig. 206). In a forward dislocation the forearm is lengthened.

**Treatment.**—The immediate treatment of a dislocated elbow consists in supporting the injured forearm in a sling and bind-



FIG. 207.—Reduction of elbow-joint dislocation (Da Costa).

ing the arm to the chest by means of a bandage or cravat (see Fig. 179). Then have the patient placed in the care of a surgeon for further treatment.

*If medical or surgical aid is not available and cannot be*

*obtained*, an attempt should be made to return the bones to their natural position. It is hard to lay down any general rule for doing this, as each variety of dislocation should be reduced by different manipulations. As most of these dislocations are of the posterior variety (see Fig. 206), they may be reduced as follows: Grasping the arm at the elbow-joint



FIG. 208.—Anterior dislocation of the hip.



FIG. 209.—Posterior dislocation of the hip.

with one hand, straighten the forearm so as to unlock the joint and make strong traction upon the partly extended forearm. Follow this by flexing the forearm (Fig. 207).

After reduction immobilize the arm and forearm in a flexed position by means of an arm sling (see Fig. 120).

**Dislocations of the Hip** are usually the result of falls from a height upon the foot or knee, with the thigh at an

angle with the spine. They are of several varieties, described according to the direction the head of the femur takes, but for all practical purposes they may be divided into forward and backward dislocations. A backward dislocation is by far the most common. In both these dislocations the limb is held rigid and pain is marked.

In forward dislocations the thigh is somewhat flexed and held outward away from the median line, the foot being also turned out. The limb may be either lengthened or shortened.



FIG. 210.—Stimson's method of reducing a posterior dislocation of the hip-joint (Fowler).

In backward dislocations the foot is turned inward, while the thigh is drawn toward or across the opposite limb. Shortening of the limb is also marked.

**Treatment.**—*Send for surgical assistance.* In the meantime place the patient flat on the back with the injured leg supported upon pillows in a position most comfortable for the patient. *Reduction of the dislocation should never be attempted if within reach of medical or surgical assistance, as they are all difficult to reduce, each variety, like those of the*



elbow, requiring some different manipulation, and usually an anesthetic to relax the muscles is necessary to insure success.

*When medical or surgical aid is not within reach*, the following methods of reduction may be tried.

*Backward Dislocations.*—The simplest method of reducing a backward dislocation, which is the most common form, is by Stimson's method, performed as follows: The patient should be placed face downward on a table with the thighs projecting sufficiently to allow the dislocated leg to hang over



FIG. 211.—Reduction of a forward dislocation of the hip.

the end of the table. The sound leg should be held in line with the body by an assistant, or, if an assistant is not available, it may be allowed to rest upon some support. The operator then grasps the ankle of the dislocated leg, and, flexing the knee to a right angle, gently rocks the leg from side to side. The weight of the leg makes traction and produces relaxation of the muscles about the hip, so that the bone soon slips back into place. Additional traction may be obtained, if necessary, by placing a five or ten pound weight on the calf of the flexed leg just below the knee (Fig. 210), or by the operator exerting pressure at this point with the free hand.

In *forward dislocations* the leg should be bent upon the thigh and the thigh upon the abdomen, the limb being slightly abducted. Then, rotating the limb inward and at the same time carrying it toward the sound side, bring it down by the side of the uninjured limb (Fig. 211).

Having reduced the dislocation, the joint should be fixed by means of a side splint (see Fig. 191). This should be kept in place two to three weeks.

**Dislocations of the Knee** are due to the application of great violence. They may occur forward, backward, outward, or inward.

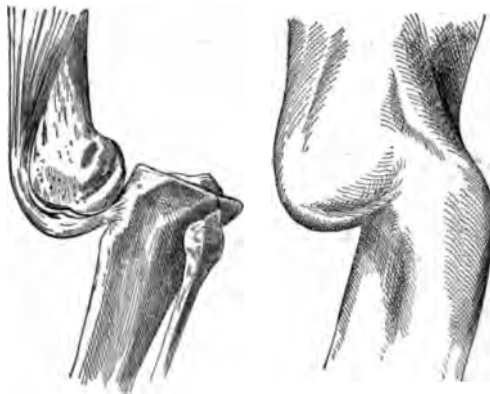


FIG. 212.—Complete posterior dislocation of the head of the tibia (Hoffa).

In the backward variety, the leg is shortened and there is a marked deformity, as shown in Fig. 212, due to the projection backward of the head of the tibia and the condyles of the femur forward.

In forward dislocations there is shortening of the limb and also a marked deformity, the reverse of the above—the tibia projects forward and the lower end of the femur backward.

In lateral dislocations, as a rule, there is no shortening of the leg, as they are rarely complete.

**Treatment.**—The immediate treatment of such an injury

until the arrival of medical or surgical assistance consists in placing the patient flat on the back with the knee supported in a comfortable position by pillows.

To reduce a dislocation of the knee, which would be necessary, if the patient were so placed that medical or surgical assistance could not be obtained, the following manipulations are performed: Bend the leg upon the thigh and the thigh upon the abdomen, and, while an assistant holds the thigh, make traction upon the leg, and push the bones into their proper position. The limb should be finally placed upon a well padded posterior splint and confined for several weeks.

#### SPRAINS OF JOINTS.

A sprain is a twisting or wrenching of a joint with tearing of the ligaments and surrounding soft parts. Sprains are common in the young, or in those whose muscles are flabby and too weak to furnish the necessary support for the joint. The joints usually affected are those of the ankle, knee, and elbow.

A severe sprain is accompanied by tearing of the ligaments about the joint and stretching of the neighboring tendons and muscles. There may be also some injury to the cartilages, and even portions of bone to which the ligaments are attached may be torn away. Accompanying these injuries there is more or less escape of blood into the joint itself and surrounding tissues.

Sprains are followed by severe pain and marked swelling of the injured part, due to the laceration of tissues and effusion of blood. The sufferer is unable to use the joint, and later discoloration develops at the seat of injury.

**Treatment.**—Sprains are most important injuries and permanent disability frequently follows from a failure to give them the proper *immediate* care. Severe sprains are even more serious than fractures. There is nothing more dangerous than to attempt to “walk off” a sprain of the ankle—advice frequently given to the recipient of such an injury.

With a slight injury to a joint, exercise may do good, often preventing later stiffness. It is, however, usually impossible to ascertain the severity of the injury at once, and for this reason *every sprain should be treated with great care*. If there is any doubt as to whether the injury is a sprain or a fracture, it should be treated as a fracture until the arrival of medical aid.

In recent sprains the first thing is to prevent any further effusion of blood into the joint. This may be accomplished by the use of pressure and cold applications. Elevate the limb and apply a firm bandage to the joint. An ice-cap may



FIG. 213.—Strapping for a sprain of the ankle.

then be applied, or the bandage may be first wrung out in cold water and then applied. Such a bandage should not be put on too tightly, as later, on becoming dry, it is apt to shrink. Leadwater and laudanum is a useful application for the relief of pain. If pain persists under the use of cold, hot applications should be tried; frequently by immersing the part in very hot water for several hours, the pain will be entirely relieved.

As swelling and pain subside, slight movements of the joint and gentle massage should be practised daily. In the intervals, keep the part immobilized by splints.

**11.** Treatment of a sprain of the ankle by immediate strapping of the joint and allowing the patient to walk about is frequently practised. For this purpose strips of adhesive plaster one to one and a half inches wide and about eighteen inches long should be obtained. The strips are applied in the manner previously described on page 154—leg strips and foot strips alternating, and overlapping the previous strip each time, until the ankle-joint is covered in (Fig. 213). Strapping in this manner furnishes pressure and, at the same time, fixes the joint and gives support to the torn ligaments.

#### STRAINS.

The wrenching or tearing of a muscle or tendon is commonly designated as a strain. Such an injury in a healthy muscle is the result of violent exertion or sudden, unexpected movements, as, for example, recovering the balance. These injuries usually occur in the muscles or tendons of the arm or legs, and may consist of a simple stretching or tearing of some of the muscle fibers or of a rupture through the entire muscle or its tendon.

When such an injury occurs in the leg, the sufferer will be seized with a sudden, sharp, excruciating pain in the injured part, and will often drop down suddenly, saying afterward he thought he had been shot or struck with a stone.

If complete rupture occurs, there will be loss of power of the affected muscle, and, on examination, there will be found a distinct gap with considerable swelling above it, due to retraction of the torn muscle fibers.

**Treatment.**—For slight strains, strapping with adhesive plaster or the use of bandages gives most comfort.

If rupture occurs, in the absence of surgical assistance, the limb should be immobilized by splints or bandages and placed in such a position that the muscles are relaxed, thus allowing the torn fibers to come together. For example, if the injury is in the leg, the knee should be flexed, being supported in this position by a pillow.

## CHAPTER XVIII.

### ASPHYXIA AND THE REMOVAL OF FOREIGN BODIES.

#### ASPHYXIA.

Asphyxia, or suffocation, is the interruption or complete suspension of the function of respiration, produced by some interference with the free passage of air to the lungs or by breathing poisonous gases. The result in either case is the same—there is a very much diminished supply of oxygen in the blood, an increased amount of carbonic acid, and consequent poisoning.

Asphyxia results from a number of causes. Among them may be mentioned drowning, hanging, strangulation, smothering, and obstruction of the air-passages from foreign bodies or from swelling of the mucous membrane which lines them.

The appearance of a person suffering from asphyxia is characteristic. The face becomes swollen and congested; the lips are blue; the eyes are bloodshot; the body is cold; and the hands and feet are swollen and livid. The breathing, which at first is labored, soon becomes spasmodic and finally ceases altogether. The heart, however, may continue beating for some minutes after all breathing has ceased.

**Treatment.**—In all cases the indications are, first, to remove the cause of the suffocation, then to establish natural breathing, and later to treat the shock by appropriate measures.

**Artificial Respiration** is a term applied to methods of starting up respirations in persons in whom the breathing has ceased. There are four well-known methods, the Sylvester, the Howard, the Hall, and the Laborde.

*The Sylvester Method.*—The patient is placed upon his back, the clothing having been previously loosened or removed

from the chest, and a pillow or folded towel is placed between the shoulders, thus elevating the chest and throwing back the head so as to maintain an open passage for the air. Make sure that the air-passages are not blocked by foreign bodies or mucus. The throat can readily be cleared by wiping it out with the fingers. Always pull the tongue well forward, and have it held by an assistant. If without assistance, it



FIG. 214.—Sylvester's method of artificial respiration. Inspiration.

may be held forward by a rubber band or piece of string placed around the tongue and secured to the chin.

Now kneel at the individual's head, facing toward his feet, and, grasping both elbows, carry the arms slowly outward away from the body and upward over the head as far as they will go. Hold them in this position for several seconds. This maneuver elevates the ribs and expands the chest, producing *inspiration* (Fig. 214). Next slowly depress the arms toward the sides, and, when the chest is reached, the elbows are slowly and firmly depressed against it, expelling the air and producing

an *expiration* (Fig. 215). These motions should be repeated at the rate of ten to sixteen times a minute.

If someone is present who can assist, he should be instructed to make upward pressure upon the margin of the ribs and upper portion of the abdomen with the outstretched hands somewhat in the manner shown in Fig. 216 while the *expiratory* motion is being made. After a second or two the assistant suddenly removes his hands, and at the same time elevation of the arms



FIG. 215.—Sylvester's method of artificial respiration. Expiration.

is again performed. This method is more efficacious than the Sylvester method alone as the counter-pressure made by the assistant's hands prevents the effects of the expiratory maneuver being lost upon the abdominal organs.

Breathing will begin in short gasps and will gradually approach the normal, but should no signs of breathing appear immediately do not be discouraged, as it may be established in seemingly hopeless cases after one to two hours' work.

*The Howard Method.*—First place the patient face downward, with a large pillow or roll of clothing under his abdomen



and chest, the forehead resting upon one arm. This position allows any fluids to flow from the lungs and also prevents the tongue from falling back into the throat. Firm pressure is made upon the left side and back for several seconds, or as long as any fluid escapes from the mouth. Then quickly turn the patient upon his back with a large roll placed under the shoulders. This causes the chest to protrude well forward, while the head extends downward and back. Secure the



FIG. 216.—Artificial respiration (Howard method).

tongue by one of the methods mentioned above, and fasten the arms up over his head.

Kneel over the patient's hips, facing him, and place the palms of the hands with the fingers spread out upon each side of the chest, then slowly press forward and inward, using the weight of the body. This expels the air from the chest and produces *expiration* (Fig. 216). Remain in this position several seconds, and then spring back, at the same time releasing the chest wall and so producing *inspiration*. Repeat these movements slowly, at first, and then at the rate of about sixteen times a minute.

**Hall's Method.**—The patient is placed face downward, with a roll of clothing under the chest, and steady, firm pressure is brought to bear between the shoulders with the hands, thus producing an *expiration*. Then, grasping him by one shoulder and hip, roll him on his side and back. This releases the chest and produces an *inspiration*.

By this method several assistants are required to manage the arms and legs.

**Laborde's method** consists of rhythmic tractions upon the tongue, and is carried out by grasping the tongue firmly with a pair of forceps or with the fingers covered by a cloth and alternately drawing it out and releasing it.

**Drowning** is a condition of asphyxia brought about by the failure of air to gain entrance to the lungs, the air-passages being blocked by water. There is a popular notion that a person has to sink under water to drown, but this is a mistake, as simply immersing the nose and mouth is sufficient to produce suffocation.

In cases of drowning there is some shock present, due to the prolonged exposure; and this may be so severe, combined with the weakness resulting from the prolonged struggle to keep afloat, that death results from heart failure before asphyxia occurs.

**Treatment.**—Remember that every minute and second are precious, so waste no time. Have all the bystanders move away so as to give the victim all the air possible. Loosen or remove the clothing from the patient's chest and neck and attempt to rid the air-passages of any water, mud, or mucus which may be present. Clear out the nose and throat, and pull the tongue well forward. Then turn the patient over, face downward, with a large roll of clothing under the abdomen, and, by making firm pressure upon the loins, any water will be expelled from the lungs and stomach (Fig. 217). If the individual does not then breathe, do not waste any more time in these preliminaries, but hastily turn him upon his back and proceed with artificial respiration (page 263). At the same

time try and stimulate respiration by having an assistant hold ammonia or smelling-salts to the nostrils. Remember, when turning the patient upon his back, to keep the tongue forward, as it is liable to fall back into the throat and block the air-passages.

In some instances the length of time breathing may be suspended is truly remarkable. Recovery from drowning has occurred where persons have been submerged from ten minutes to nearly an hour. Do not despair if resuscitation does not



FIG. 217.—Expelling water from the stomach and lungs (Murray).

immediately follow; cases have been reported where it has taken two hours to effect this.

When breathing has become established, carefully remove all wet clothing and wrap the patient up in warm, dry blankets, applying heat to the extremities. Restore the circulation by brisk friction applied to the limbs, and, as soon as he is able to swallow, give small quantities of hot coffee, whiskey, or brandy.

**Hanging, or Strangulation.**—Cut the person down immediately, if still suspended, and promptly remove any constriction from the neck. Remove the clothing from the chest and attempt to excite breathing by dashing cold water upon the face and body. If this fails, perform artificial respiration (page 263).

**Choking.**—It is a common accident as the result of foreign

bodies or particles of food lodging in the throat. (For treatment, see under Foreign Bodies in Larynx (page 271).)

**Asphyxia from Poisonous Gases.**—Asphyxia may follow the inhalation of gases from the combustion of charcoal, coal, or coke. It may also result from illuminating gas, smoke, foul gases from sewers, wells, or mines, and from certain chemicals, as chlorine, chloroform, etc.

**Treatment.**—Remove the patient as quickly as possible to a pure atmosphere and attempt to resuscitate by artificial respiration (page 263).

In rescuing a person from the presence of poisonous or foul gases, there are some cautions to be observed. Never carry a light or strike a match in a room where gas has been escaping until the room has been thoroughly aired; likewise avoid carrying a light into a sewer, well, or mine, as the gases they contain are often inflammable. In rescuing a person from a room full of gas or smoke take a full breath and rush to the nearest window, which should be quickly raised or broken open. This will allow the rescuer to get a supply of fresh air, after which other windows and doors should be opened to create a draught and expel the gas. Before entering any foul atmosphere it is well to have the nose and mouth protected by a cloth or sponge saturated with water or vinegar.

#### FOREIGN BODIES IN THE EYES, EAR, NOSE, LARYNX, AND ALIMENTARY CANAL.

**Foreign Bodies in the Eye.**—Particles of dirt, sand, cinders, or fine pieces of metal are frequently blown into the eye and lodge there. They not only cause a feeling of discomfort, but, if not removed, set up an inflammation which is very painful as well as dangerous. Fortunately nature, through an increased flow of tears, dislodges most of these substances before any harm is done.

**Treatment.**—*In no case should the eye be rubbed*, as such a procedure is apt to drive any particles deeper into the tissues, and later it becomes a difficult matter to remove them. If the

foreign body lodges under the upper lid, it may sometimes be removed by drawing the upper lid well down over the lower

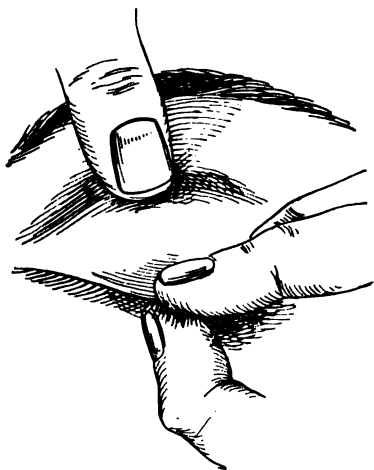


FIG. 218.—Preliminary step in everting the upper eyelid (Pyle).

lid, and, as the upper lid returns to its normal position on being released, its under surface will be drawn over the lashes of the lower lid, and any particles will be dislodged. Another method is to grasp the eyelashes between the thumb and forefinger of one hand and turn the lid up over the tip of the finger (Fig. 218), a match, or pencil, thus exposing its under surface (Fig. 219), from which any particles may be carefully removed by means of the

corner of a handkerchief, a camel's-hair brush, or a loop of fine wire.

Particles lodged under the lower lid may be removed in the same manner, simply pulling down the lower lid and exposing its inner surface.

Should a foreign body become firmly lodged in the substance of the eye, medical assistance must be sought.

**Foreign Bodies in the Ear.**—Small insects, ants, flies, or bugs may gain access to the ear. It is not

a common accident, however, and is usually the result of sleeping or lying in the grass. Insects cause great discomfort

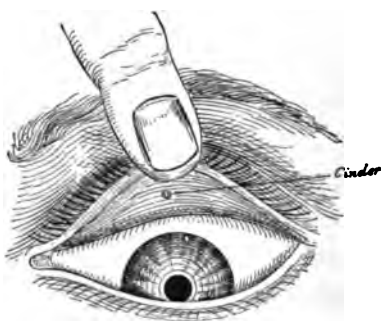


FIG. 219.—The upper eyelid everted (Pyle).

by moving around, and it may be a difficult matter to dislodge them. Other bodies, as corn, beans, buttons, or small seeds are often introduced into the ear by children. Such substances as seeds absorb moisture and are thus dangerous, as they swell up after entering the ear, making it a difficult matter to dislodge them, and they often produce a very painful inflammation.

**Treatment.**—The only instrument that should be employed by one unskilled in such work is a syringe. *On no account should pins or pieces of wire be inserted into the ear to dislodge a foreign body.*

Insects may be killed by dropping a little sweet oil into the ear, and may then be removed by syringing out the ear with sweet oil or soap and water.

In the case of seeds, water cannot be used, but some liquid like alcohol, which will cause the body to shrink, should be employed. If syringing fails, attempt nothing more, but obtain medical aid.

**Foreign Bodies in the Nose.**—Foreign substances rarely remain long in the nose, as the violent sneezing they occasion is usually sufficient to dislodge them.

**Treatment.**—Encourage sneezing by means of snuff or irritation of the opposite nostril. Violent blowing of the nose, with one nostril closed, may dislodge the body. Should this fail, consult a physician.

**Foreign Bodies in the Larynx.**—Pins, coins, needles, fish-bones, false teeth, and particles of food often become lodged in the larynx or throat. While there is not, as a rule, a complete obstruction to the passage of air, symptoms of suffocation more or less severe are present—the victim's face becomes livid, he gasps for breath, and has violent fits of coughing.

Particles of food are frequently sucked into the larynx by a sudden inspiration while eating, so it should be remembered that it is a dangerous thing to laugh while anything is in the mouth.

**Treatment.**—In all cases an attempt should immediately be made to remove the obstruction. Frequently by simply pass-

ing a finger into the throat the body may be felt and easily removed. Hence, *in any case of asphyxia an examination of the throat should always be promptly made.* Substances deeper down cannot be felt in this way, but may be dislodged by producing coughing or by slapping the person on the back. If this fails, the patient should be inverted, or literally stood on his head, with the hope of dislodging the body. If still unsuccessful, send immediately for a physician. In the meantime, if there is danger of asphyxia, perform artificial respiration (page 263).

**Foreign Bodies in the Alimentary Canal.**—Children or insane persons sometimes swallow pins, coins, nails, etc. They may lodge in the esophagus, producing difficulty in swallowing, but more often pass on into the stomach and appear later in the passages.

**Treatment.**—It is dangerous to attempt to dislodge the foreign body by producing vomiting. Avoid also giving purgatives, as they cause an increased movement of the intestines, and, in the case of a pin or sharp object, a perforation of this canal might result.

The best plan is to feed the person on bread and milk or mush for a day or two with the hope that the foreign body will become surrounded and be carried on into the intestines. Later, a mild laxative may be given.

## CHAPTER XIX.

### UNCONSCIOUSNESS.

Unconsciousness, or coma, is simply a symptom of some other trouble, and at times it may be a difficult matter to ascertain its cause. Some of the more common conditions accompanied by unconsciousness are alcoholic intoxication, apoplexy, asphyxia, compression and concussion of the brain, convulsions, epilepsy, hysteria, certain forms of poisoning, shock, syncope, sunstroke, and uremic coma. To this list may be added a class of individuals who make a business of "throwing fits" to obtain a drink of liquor or a small sum of money which some sympathetic bystander will be sure to give them.

**Examination of an Unconscious Person.**—It will readily be seen how important a matter it is always to ascertain the cause of the condition before beginning any treatment, for it is obvious that the treatment of a case of opium poisoning, for example, must of necessity differ from that of a case of apoplexy. Hence a most careful and thorough examination of the patient should always be made.

Learn all you can from the bystanders as to the condition in which the patient was found, and whether he fell or received an injury. At the same time place him flat on his back, loosen all the clothing from the neck and chest, and, above all, provide plenty of breathing space by keeping the curious bystanders back.

The appearance of the patient should be carefully observed. Note whether the skin is livid in appearance, or pale and cold. A livid skin will be found as an accompaniment of apoplexy, epilepsy, forms of hysteria, and many other conditions. A pale, moist skin usually denotes concussion of the brain, shock, or hemorrhage. A very hot skin is a sign of fever or sunstroke.

Examine the head for the presence of wounds or fractures.



Notice whether the sufferer has convulsions, and examine the tongue to see if it has been bitten. Convulsions, especially epileptic, are liable to be accompanied by some injury to the tongue.

Smell the breath, but don't conclude that because it has an odor of alcohol that the person is necessarily simply intoxicated. He may have had a drink when he was taken sick or some one may have forced it down his throat while lying unconscious. Notice if the breathing is slow and labored, or fast. Noisy, stertorous (snoring) respirations, accompanied by flapping of the cheeks, usually denote apoplexy or some injury to the brain.

Notice whether the pulse is full and bounding, or rapid and weak. A full bounding pulse may indicate fever, apoplexy, or uremia; a rapid, weak pulse denotes shock; a very slow pulse is found in compression of the brain.

The eyes should always be examined, as they can give important information. Expose the pupils by gently lifting up the eyelids, and notice whether they are dilated (large) or contracted (small) and whether they are alike in size. When both pupils are much contracted, it is usually an indication of some narcotic poisoning. When one is dilated and the other contracted, it may be taken as an indication of some injury to or pressure upon the brain. The depth of insensibility may also be judged by touching the clear portion of the eyeball with the finger. If totally unconscious, this will have no visible effect upon the patient; if partly unconscious, the individual will flinch or resent such a procedure by frowning.

Examination of the ankles should be made for swelling or edema; such a condition is usually an accompaniment of Bright's disease or uremic coma. The existence of edema may be discovered by forcibly pressing upon the part with the finger; if present, the imprint will remain.

The limbs should be carefully examined for fractures or indications of paralysis. It may appear a difficult matter to ascertain whether an unconscious person is paralyzed, but, by simply lifting the limbs and dropping them, it will be found

that on the paralyzed side the limbs drop limp and as if dead, while on the other side they fall slowly. Do not make the mistake, which has been made, of pronouncing a limb paralyzed because it dropped limp, where, as a matter of fact, a simple fracture existed.

It should be remembered that sometimes only by a most careful and systematic examination can a correct diagnosis be made. By following the above suggestions serious mistakes may be avoided.

#### ALCOHOLISM.

The use of alcohol, if carried to excess, produces a condition of unconsciousness which is very apt to be confounded with other allied conditions. Too great care cannot be taken in examining these cases thoroughly, as mistakes are of frequent occurrence, and cases of fractured skull or apoplexy are often pronounced mere alcoholism. Do not be led astray by the fact that a person has an odor of liquor about him. He may have been drinking and had a stroke of apoplexy, or may in falling have fractured his skull. If there is the least doubt it is better to give the patient the benefit than to run any risks.

A person suffering from alcoholic coma lies in a stupor, but can usually be partially aroused and made to answer questions. The face is flushed, the pulse is full and rapid, and the respirations are deep. The pupils are usually dilated, and the breath has the heavy odor of alcohol.

**Treatment.**—Ordinary intoxication rarely requires any treatment besides rest and sleep. If the patient is in an exhausted state it is well to wash out the stomach or give an emetic, such as mustard and warm water. Then cover him warmly and apply heat to the extremities. If coma is present, try to arouse the patient by cold douching or striking with wet towels. If the pulse is weak, stimulants should be given; inhalations of ammonia, the internal use of strychnine or caffeine may be employed. The use of strong coffee by the rectum is of great service.

**APOPLEXY.**

Apoplexy is a condition of unconsciousness due to rupture of a blood-vessel of the brain, the resulting pressure from the blood-clot causing a loss of consciousness and paralysis. Apoplexy usually occurs in those past middle age. It is often the result of great mental excitement, although it may occur during sleep.

A person about to have an apoplectic fit may have warning by a slight dizziness, a feeling of pain in the head, or a numbness in the limbs; but, as a rule, the attack is abrupt; there is a sudden loss of consciousness and the patient falls to the ground. The face usually appears blue or cyanotic; the pupils are either equally dilated, or else one is dilated and the other contracted; the pulse is full and hard; the respirations are noisy, and with each respiration there is a flapping of the cheeks and a sputtering from the lips. There is usually paralysis of one side of the body, and the head or eyes may be turned to the opposite side. The unconsciousness is profound, and the patient cannot be aroused.

Apoplexy differs from alcoholism in the following respects: An individual suffering from apoplexy will be deeply unconscious; if suffering from alcoholism he can be aroused. With apoplexy the limbs on one side are usually paralyzed; with alcoholism no paralysis exists. In apoplexy the pupils are liable to be unequal; in alcoholism they are equal.

**Treatment.**—The treatment consists in absolute quiet and rest to prevent any further hemorrhage. Have the sufferer put to bed with the head slightly elevated; apply cold to the head by means of cold cloths or an ice-cap. Heat may be applied to the feet, *but avoid giving stimulants*. Of course, always summon medical aid.

**CONCUSSION OF THE BRAIN.**

Concussion of the brain, or contusion, as it is sometimes called, is a jarring or shaking up of the brain substance produced, as a rule, by falls or blows upon the head. Such an

injury is always accompanied by more or less bruising of the brain substance.

Falling and "seeing stars" is a slight form of concussion which many of us have at some time experienced; or the jarring of the brain may have been more severe, leaving us weak, nauseated, and confused for some time afterward.

In the more severe forms of concussion the patient remains apparently unconscious, although he can be aroused and will answer questions, soon becoming drowsy again if left alone. The skin is pale and moist; the temperature is subnormal; the pulse is rapid and irregular; the respirations are frequent and shallow. The pupils respond to light and are either normal in size or else contracted. Patients, as a rule, react soon, but they may feel dizzy for some time after.

**Treatment.**—Place the patient flat on the back with the head slightly raised. Heat may be applied to the extremities, and cold to the head, but *avoid the use of stimulants*.

#### COMPRESSION OF THE BRAIN.

Compression of the brain may be caused by blood-clot, bone (as in fractured skull), or foreign bodies.

A person suffering from such an injury is in a state of total unconsciousness from which he cannot be aroused. The breathing is noisy as in apoplexy; the pulse is slow and full; the pupils are dilated or unequal and do not respond to light; the temperature of the body is generally subnormal. Paralysis of one side of the body is also a usual symptom.

**Treatment.**—The only means of treating compression of the brain is to remove its cause. In the absence of a surgeon, place the patient in a recumbent position with the head slightly raised. Should any wound be present, do not fail to apply some temporary dressing (see page 149).

#### CONVULSIONS OF CHILDREN.

Convulsions in children may be due to beginning cerebral diseases, to reflex irritation, or may be symptoms of some acute

sickness. Meningitis, cerebral hemorrhage, tumors of the brain, abscess of the brain, hydrocephalus, etc., are the most frequent diseases of the brain accompanied by convulsions. Worms, teething, indigestion, and severe injuries may be taken as examples of reflex irritation. Pneumonia, measles, scarlet fever, typhoid fever, etc., in children are often ushered in by convulsions. In a child, they have much the same significance as a chill has in an adult.

During a convulsion the child's body becomes rigid and stiff; the hands are clenched; the eyes are fixed or sometimes rolled up; the breathing is shallow and labored; and the face is first pale, later becoming livid and dusky. Convulsive movements and twitching of the face and limbs follow, or unconsciousness and stupor may result. Usually following the convulsions a condition of general relaxation with some evidence of collapse occurs; or the child may drop off into a quiet sleep.

**Treatment.**—*Always send for medical aid.* In the meantime, place the child in a warm bath and apply cold to the head, or the child's feet may be simply placed in a warm mustard bath (see page 163) with the body warmly covered. If convulsions reappear, the treatment should be continued.

#### EPILEPSY.

Epilepsy is a nervous affection accompanied by sudden attacks of unconsciousness, generally with convulsions.

Those subject to epileptic fits sometimes have a warning of an attack by an uneasy sensation and a feeling of apprehension, but more often the individual simply gives a sharp cry and falls to the ground in a convulsion. The jaws are fixed, the head is thrown back, and the hands are tightly clenched. The face is livid, and the pupils are dilated. A spasm of the muscles soon follows, which lasts for several minutes; the eyes roll and the eyelids alternately open and close. During a spasm the tongue may be caught by the teeth and be bitten. Frothing at the mouth is characteristic of epilepsy, the saliva being often blood-stained. The muscular spasm soon passes off,

the muscles relax, and the patient regains consciousness, or else he remains in a semiconscious or stupid state for some time. Epileptics rarely have any recollection of having had a fit on regaining consciousness.

**Treatment.**—This should consist in preventing the sufferer from harming himself during a convulsion. The attack is not as a rule dangerous in itself, so simply loosen the clothing from the patient's neck and chest, and place something between the teeth to prevent injury to the tongue—a cork or small piece of wood will answer for this purpose. If necessary have some one restrain the patient during the convulsion to prevent injury to the limbs. Following an attack the patient should remain quiet for some time.

#### HYSTERIA.

Hysteria is a disease of the nervous system accompanied by loss of control over the emotions. It usually is seen in women, but may also be present in nervous men. The disease is manifested in a great variety of ways, but the only form we shall consider is that accompanied by convulsions. In this form hysteria may closely resemble epilepsy.

The patients usually have an attack of laughing and crying, and gradually work themselves up to such an extent that they fall in a convulsion. The attacks are sometimes prolonged for several hours, and, upon recovery, it is not uncommon to find them laughing or sobbing for some time after. They appear to be unconscious, but in falling they always pick out some soft spot or chair to fall upon and are careful not to injure themselves. The tongue is rarely bitten in hysteria.

Hysteria may be mistaken for epilepsy, but in the latter condition the fall is sudden, and the sufferer frequently receives painful scalp wounds or injuries to the tongue.

**Treatment.**—While hysteria is a disease, the patient should nevertheless be treated with firmness. The subjects usually crave sympathy. To sympathize with such a patient is the worst possible thing and will simply prolong the attack

or hasten another. The best thing to do is to leave the patients alone—of course seeing that no harm can come to them. When they recover and find themselves alone and without sympathy, they will not be so apt to repeat the attacks. In prolonged convulsions, throwing water in the face will usually terminate the seizure.

#### **MALINGERERS.**

Under this heading are included beggars who “throw fits” to obtain money from sympathetic persons, and other unfortunates who resort to such practices with the hope of obtaining a night’s lodging in some hospital or, at least, a drink of liquor. These cases are frequently met with in the large cities and are the bugbear of the young ambulance surgeons. Mention of them is simply made as a warning against such impostors.

Many ingenious practices are resorted to in faking different kinds of fits. Epilepsy is more commonly faked, probably because it is easy to simulate this disease. With a small piece of soap held in the mouth the frothing characteristic of the disease is produced, and by twitching and holding the breath a condition so resembling epilepsy may be exhibited that at times it is difficult to detect the imposition. Malingerers, however, rarely go so far as to injure the tongue, and in falling they are careful to do themselves no harm.

#### **SHOCK.**

Shock, or collapse, may be defined as a condition of depression affecting the vital functions of the whole system. The action of the heart becomes weak and there is a dilatation of the blood-vessels of the internal organs, so that an accumulation of blood occurs in the interior of the body and the amount of blood circulating in the periphery is decreased.

Shock may be the result of great fear or grief. It may be due to hemorrhage, to injuries about the abdomen, to burns and scalds, to excessive cold, to gunshot wounds, or to severe lacerations and contusions—in fact, any injury severe enough

to produce a marked depressing effect upon the nervous centers will result in more or less shock.

A person suffering from severe shock lies in a drowsy condition, with the limbs limp, but is not totally unconscious. The skin is pale and cold; the temperature is subnormal; the pulse is feeble, fluttering, and rapid, and may be irregular and barely perceptible; the respirations are shallow and sighing; the pupils are generally dilated. Great thirst is frequently an accompaniment of shock, especially if caused by hemorrhage. The sensibility of these patients is often lowered, and they do not feel pain as acutely as in a normal condition.

Shock may result in immediate death from heart failure, or a condition, known as *reaction*, may be established. This state is frequently ushered in by vomiting and is characterized by a gradual return of color to the skin and a rise of the bodily temperature. There is an improvement in the heart's action, and the respirations become fuller and deeper. After reaction is established it is not unusual for the patient to fall into a sound sleep.

**Treatment.**—Cases of profound shock are most dangerous and require energetic treatment. The object should be to bring about reaction; the longer it is delayed, the worse is the outlook. The patient should be immediately put to bed, with the head lowered. Heat should be applied to the heart and extremities (see page 162), and the body should be kept warmly covered with blankets. Friction applied to the limbs aids greatly in restoring the circulation. It is useless to give stimulants by the mouth until reaction has been established, as they simply remain in the stomach unabsorbed. A teaspoonful of brandy or whiskey or  $1/30$  of a grain of strychnine may be given by hypodermic injection. Stimulating rectal enemata (see page 166), consisting of half an ounce of whiskey to two pints of hot salt solution, are very valuable. In cases of shock from hemorrhage, the *stimulants should be omitted*.

When reaction is established, stop stimulating the patient and give hot coffee or hot fluids by the mouth in small quan-



tities. Coffee is especially valuable in quenching the thirst which is so often present.

#### SYNCOPE.

Syncope, or fainting, is a condition of temporary unconsciousness due to a diminution of the supply of blood to the brain. This cerebral anemia, as it is called, may be the result of a great loss of blood whereby the supply to the brain is diminished, or it may be due to a sudden weakening of the heart's action from severe pain, fright, great mental excitement, or complete exhaustion. Fainting usually lasts but a short time and is not, as a rule, fatal. Women are more prone to it than men.

Before fainting, the individual may complain of feeling weak and dizzy and may have a roaring sound in the ears; at other times he becomes suddenly weak and falls in collapse. The pulse is weak, the respirations are rapid, and the skin is pale and clammy. The unconsciousness rarely lasts more than a few moments.

Syncope and shock resemble each other in many ways and are frequently confounded. Syncope is temporary, however, while shock is a more serious and permanent condition, usually following severe injuries. Shock is seldom accompanied by complete unconsciousness.

**Treatment.**—In most cases simply lowering the head will prevent fainting or will speedily relieve a person who has fainted. Lay the patient down flat on his back with the head lower than the feet, providing plenty of fresh air and removing all tight clothing from the neck and chest. This, combined with sprinkling cold water in the face or the application of smelling salts or ammonia to the nostrils, is generally sufficient to arouse him. When the patient is conscious and able to swallow, brandy or whiskey may be given in small amounts. The patient should remain quiet in the recumbent position for some time after recovering from the faintness.

**SUNSTROKE.**

Sunstroke is a condition produced by long exposure to great heat. Two forms are recognized: heatstroke and heat exhaustion.

*Heatstroke* (thermic fever, heat apoplexy) is due to exposure to the direct rays of the sun. Those affected are usually already debilitated or weakened by excessive drinking, though heatstroke may occur in healthy individuals who are compelled to labor hard while exposed to the effects of the sun.

The seizure may come on very suddenly, and the man be stricken down and die immediately. More often he first experiences a feeling of weakness and dizziness, combined with a sense of oppression. This is soon followed by unconsciousness. The breathing is rapid and labored, the pulse is weak and irregular, and the temperature is extremely high, at times reaching 106° to 110°. By simply placing the hand upon the patient's body one can readily appreciate the high temperature. The pupils in these cases are usually contracted, and convulsions may occur. Should he recover, he is more susceptible to a second attack and afterward is unable to stand much exposure to heat without feeling exhausted.

*Heat exhaustion* is due to hard work and confinement in a close, hot atmosphere. The symptoms are those of collapse, the patient first complaining of feeling tired and weak. The skin becomes pale and moist, the pulse is rapid and weak, and the temperature is usually subnormal.

The two conditions are easily recognized and should be readily differentiated. In heatstroke there is complete unconsciousness, and the body feels as if it were on fire; in heat exhaustion the patient is simply dazed, and the skin is pale, cool, and moist.

**Treatment.**—In heatstroke the object should be to reduce the temperature as rapidly as possible to the normal. This may be accomplished by the removal of the sufferer to a cool place and the free application of ice to the head and spine. If possible, remove the clothing and place the patient in a cold

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bath, at the same time rubbing the body briskly to bring the overheated blood to the surface. (See Cold Bath, page 160.)

In heat exhaustion usually all that is required is rest and the use of stimulants. If the temperature is below normal, cover the body warmly with blankets and apply heat to the extremities.

#### UREMIC COMA.

Uremic coma, or uremia, results from a diseased condition of the kidneys, with retention in the body of certain poisonous materials which should be normally excreted. It is a common accompaniment or termination of Bright's disease.

The condition may be ushered in by symptoms of headache, dizziness, and spots before the eyes, soon followed by convulsions and total unconsciousness. Usually the temperature is subnormal; the pulse is slow and full, or rapid and bounding; the pupils are small; the skin is dry, and there is an odor of urine to it and the breath. The patient's appearance is also characteristic. He is pale and has a bloated look, with swelling about the face and eyelids and edema of the ankles.

**Treatment.**—This is a very serious condition and needs prompt attention. In the absence of a physician, give a purgative if the patient is conscious, and attempt to excite the skin to action through sweating. This may best be effected by giving a hot pack (page 163). A hot bath, followed by closely surrounding the body with warm blankets and plenty of hot bottles, may accomplish the same result.

## CHAPTER XX.

### POISONING AND ITS TREATMENT.

A poison, as commonly understood, is any substance which if taken in small quantities will injure the health or produce death.

Many cases of poisoning by such substances are the result of their being taken with deliberate intention, but the cases occurring from carelessness or mistake are of such frequent occurrence as to call forth needed censure upon the manner in which many people handle poisons. In the newspapers every little while one may read of cases of children dying by drinking some deadly poison left within reach, or of adults who have accidentally taken poison through mistaking it for something else. In order to avoid such accidents all bottles or boxes containing any drug should be clearly labelled, and anything as to the nature of which there is any doubt should be thrown away. Furthermore, poisonous drugs should always be kept in bottles of such peculiar form or shape that a person's attention would be immediately attracted on taking hold of them. In most hospitals such drugs are kept in bottles the external surfaces of which are studded with small shot-like knobs, giving them such a roughened feel that they cannot be mistaken for anything else, even in the dark.

**Classification of Poisons.**—Poisons are divided, according to their action, into neurotics, irritants, and corrosives.

**Neurotics** produce their effect upon the nervous system; they seldom have any local effect, acting only after being absorbed into the circulation. Some produce sleep, stupor, and coma (narcotics); some intoxication (inebriants); some insensibility (anesthetics); some spasms (convulsives); and others cause faintness or marked depression (depressants).

To this class belong opium, chloral, aconite, belladonna, alcohol, hemlock, chloroform, hyoscyamus, nicotine, prussic acid, strychnine, and poisonous fungi.

**Irritants** produce a burning sensation in the stomach, followed later by an inflammation of that organ; some time elapses, however, before the symptoms appear. The chief irritants are arsenic, antimony, cantharides, phosphorus, salts of copper, mercury, zinc, dilute acids, and tainted foods.

**Corrosives** have a marked local action, destroying all tissues with which they come in contact. They leave a metallic taste in the mouth and produce a burning pain in the throat and stomach. The symptoms come on promptly and are accompanied by collapse. Mineral acids, caustic alkalies, oxalic acid, carbolic acid, and corrosive sublimate belong to this class.

The above classification is in accordance with the most characteristic action of the drugs, but some of these poisons may have a combined action; nicotine, for example, is both an irritant and neurotic poison.

**General Treatment of Poisoning.**—*Always send for medical aid promptly.* In the meantime learn, if possible, what substance has been taken and whether the person is really suffering from poisoning. As a general rule poisoning is characterized by suddenness in onset and by the appearance of its characteristic symptoms of pain, vomiting, and collapse within a short time after a person, apparently healthy and in good condition, has taken something into the stomach. In the treatment bear in mind the following directions:

1. *Empty the stomach of the poison as quickly as possible.*
2. *Neutralize what cannot be removed.*
3. *Counteract the depressing effects of the poison.*

**To Empty the Stomach.**—This may be accomplished by means of a stomach-pump, or stomach-tube, or by the use of emetics. As the passage of a stomach-tube or stomach-pump requires some skill, their use should be left to a physician. In some cases, however, the stomach may be satis-

factorily washed out by having the patient drink one or two glasses of tepid water and then producing vomiting by irritation of the throat with a feather or the finger.

*Emetics* are drugs which have the property of producing vomiting. Of the more common emetics these may be mentioned:

*Sulphate of zinc* (white vitriol); twenty grains may be given in half a glass of warm water.

*Copper sulphate*; give ten grains in half a glass of warm water.

*Ipecac*; give about thirty grains of the powder or two tablespoonfuls of the wine or the syrup in half a glass of water.

*Apomorphine*; it is given hypodermically in the dose of  $\frac{1}{12}$  to  $\frac{1}{6}$  of a grain.

*Mustard*; a teaspoonful in half a glass of warm water is an excellent emetic and usually available.

Plain *warm* water in large quantities (one pint), or a tablespoonful of salt to a glass of warm water, also act as emetics.

In cases of poisoning by corrosives, the *stomach-tube* or *emetics* should not be used.

**To Neutralize the Poison.**—For this purpose the proper antidote should be given. Antidotes are substances which render poisons inert and counteract their ill effects; they may be given by the mouth or through the stomach-tube after washing out the stomach. Antidotes are spoken of as chemical or physiological.

*Chemical antidotes* are substances which, if brought in contact with poisons, exert a direct chemical action upon them, either destroying their poisonous properties or changing them into such a form that they are harmless.

*Physiological antidotes* have no direct action upon poisons, but, when taken into the system, have an action which is antagonistic to that of the poison and produce symptoms which are directly the opposite to those produced by the poison.

The proper antidotes will be found under each special poison.

**To Counteract the Depressing Effects of the Poison.**—Stimulants should be used freely and are especially indicated in narcotic poisoning. They may be given by the mouth, hypodermically, or by the rectum. Brandy, whiskey, or strychnine are to be given when there is great collapse. Strong coffee given by rectal enema is most useful in some cases. Heat or mustard plasters should be also applied to the heart and extremities when collapse is threatened.

In poisoning from corrosives or irritants, pain is a prominent symptom. It may be controlled by giving one-quarter of a grain of morphine hypodermically or fifteen to twenty drops of laudanum in water by mouth. These doses are suitable for adults; for children much smaller amounts should be given, depending on the age.

#### THE TREATMENT OF SPECIAL FORMS OF POISONING.

##### ACETANILID.

Acetanilid is a common ingredient of headache powders.

**Symptoms.**—The most prominent symptom is marked lividity of the face and lips. The patient's forehead and body are often covered with perspiration. There is marked restlessness at first, often followed by unconsciousness. The pulse is soft and slow and respirations are shallow and labored. Vomiting may be present.

**Treatment.**—Empty the stomach. Keep the patient recumbent. Apply heat to the heart and extremities (see page 162), and give whiskey, brandy, or strong coffee by rectum. Employ artificial respiration (page 263) if the respirations are labored or stop.

##### ACIDS.

Strong **mineral acids**, as hydrochloric (muriatic or spirits of salt), nitric (aquafortis), and sulphuric (oil of vitriol).

They are all corrosives and cause a great destruction of tissues.

**Symptoms.**—Staining of the mouth and lips is produced—nitric acid leaves a golden-yellow stain, hydrochloric acid a lemon-colored stain, and sulphuric acid a black stain. The victim experiences a burning sensation or sharp pain extending from the mouth to the stomach directly the poison is swallowed. This is soon followed by swelling of these tissues which renders swallowing very difficult. Vomiting occurs, and there is marked shock and collapse, accompanied by a cold, moist skin.

**Treatment.**—Do not give emetics or use the stomach-pump. *Alkalies are antidotes for acids.* Give immediately one or two teaspoonfuls of baking soda, washing soda, magnesia, powdered crayons, plaster from the walls, or white-wash dissolved in half a glass of warm water; or else give a glass of lime water or thick soap suds. Follow by administering the whites of several eggs beaten in milk, a glass of olive oil, a tablespoonful of castor oil, or some other mucilaginous drink. Stimulants may be given by the rectum or hypodermically.

**Vegetable Acids,** as acetic, oxalic, and tartaric.

**Symptoms.**—They produce a burning pain in the mouth, a feeling of constriction about the throat, and are followed by shock and prostration.

**Treatment.**—In the case of tartaric or acetic acid use any of the alkalies mentioned above. In oxalic-acid poisoning use only chalk or lime-water.

**Carbolic Acid (phenol) or Creosote.**—The former is one of the most deadly and rapidly acting poisons known.

**Symptoms.**—The same symptoms as in any acid poisoning may be met with, or there may be sudden unconsciousness and death from collapse. An odor of the acid can usually be detected upon the breath, and white eschars are present upon the lips. If a person survives long enough, the urine becomes greatly decreased in quantity and is cloudy or black in appearance.

**Treatment.**—*The antidote is alcohol or some soluble sul-*



*phate*, as Epsom or Glauber salts. The former is given in the form of brandy or whiskey or *well diluted* alcohol; the latter in the dose of a tablespoonful of the salt in a glass of water. Later, give the whites of several eggs beaten in milk, a glass of olive oil, or a tablespoonful of castor oil. Collapse is a prominent symptom and should be treated by means of heat applied to the heart and extremities (see also page 162).

**Hydrocyanic Acid** (prussic acid) is a transparent, colorless liquid with an odor like that of bitter almonds. It is present in potassium cyanide, laurel, laurel-water, peach- and cherry-pits, and the oil of bitter almonds. Hydrocyanic acid is a very deadly poison, one drop of the pure acid being sufficient to produce death.

**Symptoms.**—The action of the poison is almost instantaneous. Occasionally the person may first feel a constriction about the throat and some giddiness, but generally he falls insensible and lies with eyes fixed and staring. The face is cyanotic and livid; the body feels cold and the skin moist; the teeth are tightly clenched; and there may be frothing at the mouth. Violent convulsions follow, and the respirations become slow and weak. Death occurs from respiratory paralysis.

**Treatment.**—There is no chemical antidote. Emetics or the stomach-pump should be immediately employed if there is time; otherwise proceed with artificial respiration and give inhalations of ammonia. Stimulate freely, apply friction to the extremities, and pour cold water over the head and spine.

#### ACONITE.

(Monk's-hood, Wolfsbane, Blue Rocket.)

Aconite is used extensively in fever mixtures, ointments, and liniments.

**Symptoms.**—They come on promptly, and consist of a burning and tingling sensation in the mouth and throat, soon followed by numbness. The skin becomes cold and moist; profuse sweating occurs; the pupils are dilated, and the eyes

are fixed; the pulse is weak and irregular; the gait is staggering, due to the loss of muscular power; great difficulty is experienced in breathing; and vomiting may be present. Death is usually due to asphyxia or collapse.

**Treatment.**—Place the patient in a recumbent position with the head low and the feet slightly raised. Employ emetics or the stomach-pump promptly, and give as an antidote half a teaspoonful of tannic acid in a glass of water or several cups of *strong* tea. Allow the patient to make no unnecessary movements, as the slightest exertion is liable to be followed by collapse. Apply heat to the extremities. Stimulants should be given freely; a teaspoonful of brandy or whiskey, strychnine gr. 1/30, or atropine gr. 1/120, may be given hypodermically. The use of strong coffee by the rectum is advisable. If necessary, artificial respiration (page 263) should be resorted to.

#### ALKALIES.

Caustic alkalies have the same effect as acids, producing a destruction of the tissues with which they come in contact. Poisoning from these agents is not common, and is usually due to caustic soda, caustic potash, lime, lye, pearlash, or strong solutions of ammonia.

**Symptoms.**—Strong alkalies produce marked pain and swelling of the lips and mouth, which is soon followed by a burning pain in the throat and abdomen. Vomiting, difficult breathing, a rapid, feeble pulse, and collapse, manifested by a cold, moist skin, ensue.

**Treatment.**—Do not give emetics or use the stomach-pump. *Weak acids are the antidotes for alkalies*; give diluted lemon-juice, orange-juice, vinegar, or *dilute* hydrochloric, citric, acetic, or tartaric acids. Later, the whites of eggs beaten in milk, castor oil, linseed oil, olive oil, or flour and water should be administered. Follow by the use of stimulants.

**ANTIMONY.**

Some of the compounds of antimony, as tartar emetic, act as irritants, but the chloride, or butter of antimony, acts as a corrosive.

**Symptoms.**—A metallic taste is left in the mouth, soon followed by a feeling of nausea and weakness. Vomiting of the most violent character is present, the vomited matter containing first the contents of the stomach and later blood. At the same time there is violent purging and diarrhea, which speedily reduces the sufferer to a state of collapse. The skin becomes cold and moist; the face is pinched and covered by a profuse sweat; the pulse becomes weak and thready; and the respirations are faint. Cramps may be present in the legs, and there is great thirst.

**Treatment.**—*The antidote is tannic or gallic acid*, given in the dose of half a teaspoonful to a glass of water; two or three cups of *strong* tea or an infusion of oak bark, which contains tannic acid, may be substituted, if the above drugs are not available. Incite vomiting, if there is reason to believe that the contents of the stomach have not been completely expelled; keep the patient in a recumbent position, and apply external heat. At signs of collapse employ free stimulation.

**ANTIPYRIN.**

(See Acetanilid, page 288.)

**ARSENIC.**

(White Arsenic, Arsenous Acid.)

Arsenic is often present in colored wall-paper, painted toys, and some colored candies; it is also an ingredient of corn-cures and rat-poisons. Paris or Schweinfurt green and Scheele's green are compounds of arsenic and copper.

**Symptoms** are those of an irritant poison. There is a feeling of faintness and a burning pain in the pit of the stomach. Vomiting and purging are present, the stools being tinged with blood and in appearance like rice-water. The expression is anxious, and the face drawn. Frequently there is a severe frontal headache. There may be cramps in the legs, and the extremities are cold.

**Treatment.**—Give emetics promptly or use the stomach-pump. *As an antidote, raw eggs beaten in milk, or freshly precipitated ferric hydrate with magnesia,* commonly known as “arsenic antidote,” may be employed; magnesia alone may be used. Follow by the use of large doses of castor oil and water, olive oil, or sweet oil. Stimulate the patient if necessary, and apply heat to the extremities.

#### BELLADONNA.

(Deadly Nightshade.)

Belladonna is an ingredient of many ointments and liniments. The active principle, atropine, is prescribed in eye-lotions.

**Symptoms.**—Belladonna causes a decrease in the quantity of nearly all fluids secreted by the body. As a result, the mouth and throat become very dry and difficulty is experienced in swallowing. The skin is flushed and dry, the pupils are widely dilated, vision is often double, and the pulse becomes very rapid. These symptoms are followed by dizziness, a staggering gait, and at times by delirium and convulsions.

**Treatment.**—Empty the stomach, and treat the collapse by heat to the extremities and the use of stimulants. Artificial respiration (page 263) may be necessary. Morphine may be given in small doses as the physiological antidote.

#### CAMPHOR.

(Gum Camphor, Laurel Camphor.)

Camphor is an ingredient of spirits of camphor, cough-mixtures, and many liniments.

**Symptoms.**—Poisonous doses cause excitement, giddiness, and headache. There is a burning pain in the stomach, and frequently the odor of the camphor may be detected upon the breath. Delirium and convulsions often occur. Collapse, with a small, weak pulse, is the usual termination.

**Treatment.**—Empty the stomach, apply heat to the extremities, and stimulate if collapse occurs.

**CANNABIS INDICA.**

(Indian Hemp, Haschisch, Ganga.)

This drug is used extensively in Eastern countries for its pleasant effects.

**Symptoms.**—There is a feeling of exhilaration and intoxication, and the mind is filled with pleasant ideas. The eyes are bright, and the pupils dilated; the limbs feel heavy, and sensibility is diminished. These symptoms are followed by a profound sleep.

**Treatment.**—There is no antidote. Empty the stomach and try to arouse the patient.

**CANTHARIDES.**

(Spanish Flies, Blister Beetles.)

Cantharides is a powerful irritant, and is used chiefly as a counterirritant or blister.

**Symptoms.**—There is an intense burning pain in the mouth, followed by vomiting and purging. The drug causes an inflammation of the kidneys and genitourinary tract, manifested by an increased desire to urinate; the urine may be blood-stained. Convulsions often occur.

**Treatment.**—There is no antidote. Empty the stomach and give such mucilaginous drinks as egg and milk, arrow-root, flaxseed tea, or flour and water.

**CHLORAL HYDRATE.**

(Chloral.)

Chloral is an ingredient of many sleeping mixtures; it is also present in "knock-out drops."

**Symptoms** resemble those of opium-poisoning. The surface of the skin is cold; the face is livid; the pulse is slow and feeble; the breathing becomes greatly diminished in rapidity; the pupils at first are contracted, but later may dilate. These symptoms are accompanied by muscular relaxation. The patient finally sinks into coma, which becomes so profound that it is impossible to arouse him.

**Treatment.**—Empty the stomach. Place the patient in

the recumbent position with the head low; apply heat to the limbs; and stimulate with strychnine, brandy, or whiskey, or give hot coffee by the rectum. Perform artificial respiration (page 263), if necessary, and attempt to arouse the patient by shouting, striking with a wet towel, or douching with cold water.

#### CHLOROFORM.

Chloroform is taken internally in the form of the spirits or water of chloroform. It is also an ingredient of many cough-mixtures and liniments. Cases of poisoning from its being taken internally are rare.

**Symptoms.**—There is an odor of the drug upon the breath. It produces a burning sensation about the lips, mouth, and stomach. Dizziness, staggering, symptoms of collapse, and unconsciousness soon follow.

**Treatment.**—Empty the stomach. Then give a teaspoonful of bicarbonate of soda in a glass of water, and attempt to arouse the patient by cold douching, etc.

#### CHLOROFORM, ETHER, AND NITROUS OXIDE (Inhaled).

**Symptoms** vary according to the stage of anesthesia. After its prolonged use, or when a dangerous point is reached, the patient's respiration becomes embarrassed; the pulse becomes weak, fast, and irregular; the face is pale or livid; the pupils dilate; there is a loss of sensibility in the conjunctivæ and a complete relaxation of the limbs.

**Treatment.**—Remove the clothing and place the patient on his back with the head low and the feet elevated. Provide plenty of fresh air. See that the tongue is pulled well forward, and remove any mucus from the throat. If this is neglected, respiration is apt to be interfered with. Perform artificial respiration (page 263), and stimulate freely. Attempts should be made at intervals to arouse the patient by shouting or slapping with wet towels.

**COCAINE.**

**Symptoms.**—These consist of nervousness, excitability, wakefulness, incoherent speech and often loss of speech, nausea and vomiting, and sometimes convulsions. The skin is very pale; the pupils are dilated; the pulse is at first rapid, later feeble and slow; respirations are at first quick and then slow and labored.

**Treatment.**—When taken by mouth first empty the stomach. Apply heat to the heart and feet and give stimulants. Morphine should be given as the physiological antidote.

**COLCHICUM.**

(Meadow Saffron.)

Colchicum is used in the treatment of gout and rheumatism.

**Symptoms.**—There is profuse vomiting and purging, the latter accompanied by severe colic. Prostration and collapse finally supervene. Severe cases are hopeless and death is said to be slow and painful.

**Treatment.**—*Use tannic acid* (half a teaspoonful in a glass of water) or *very strong tea as an antidote*. Empty the stomach and give mucilaginous drinks. Then apply heat to the heart and extremities, and stimulate freely.

**CONIUM.**

(Hemlock.)

**Symptoms.**—There is muscular weakness and loss of control over the limbs. The patient staggers on attempting to walk; the legs feel heavy; the arms fall powerless. Vision is often disordered; the eyelids drop and the pupils dilate. Respiration becomes difficult. Death finally occurs from asphyxia.

**Treatment.**—Rid the stomach of its contents and give tannic acid (half a teaspoonful in a glass of water) or *strong tea*. Stimulate with strychnine, and apply heat to the heart and extremities. If necessary, employ artificial respiration (page 263).

**COPPER.**

The salts of copper, as the sulphate (blue vitriol, blue stone) or the subacetate (verdigris), in large quantities are very poisonous. Canned fruit contaminated with copper salts and food cooked in a copper vessel are liable to produce poisoning.

**Symptoms** are the same as other irritants. There is a metallic taste in the mouth and a burning sensation in the stomach, soon followed by vomiting, the vomited matter being green; diarrhea and colicky pains in the abdomen occur. Finally, the sufferer is attacked with convulsions.

**Treatment.**—*Potassium ferrocyanide is the antidote*, but, in its absence, some form of albumin, as the white of eggs, which forms an inert compound with copper salts, may be given. Follow by the use of linseed oil, sweet oil, or flour and water. The later treatment consists in giving full doses of potassium iodide.

**CORROSIVE SUBLIMATE.**

(Bichloride of Mercury.)

Corrosive sublimate is used extensively as a disinfectant and antiseptic. It is a mild corrosive poison.

**Symptoms.**—There is a metallic taste in the mouth; the lips and tongue may be stained white; cramps and colicky pains are felt over the abdomen, soon followed by vomiting and purging. The skin becomes cold and moist, and other symptoms of collapse are present.

**Treatment.**—Emetics may be given. *Albumin or the white of egg acts as an antidote.* The white of one egg should be given for every 4 grains of mercury. Stimulate freely at signs of collapse. Later, give mucilaginous drinks and full doses of potassium iodide.

**CROTON OIL.**

This is one of the most powerful irritants known. It is a pale yellow fluid resembling castor oil, but has a burning taste.



**Symptoms.**—After a poisonous dose violent vomiting and purging, with severe pain and cramps in the abdomen, occur almost immediately. This is followed by rapid collapse.

**Treatment** consist in the prompt use of emetics, followed by giving the whites of eggs or milk and flour. Stimulate the patient freely. Morphine may be required for the relief of the pain.

**DIGITALIS.**  
(Foxglove.)

Digitalis is used as a heart stimulant. It is cumulative in its action—that is, after its long-continued use sudden symptoms of poisoning may occur without any increase in the amount taken.

**Symptoms.**—The effect of this drug upon the heart is characteristic. The pulse at the wrist may be slow and full, or may not be perceptible at all, and yet the heart will be heard beating tumultuously and out of all proportion to the pulse-rate. This is due to the direct action of the drug upon the heart muscle. Headache is a prominent symptom. Digitalis is a mild irritant, and nausea, vomiting, colicky pains, and cramps may occur. The skin is pale and collapse soon follows, the patient remaining conscious to the end.

**Treatment.**—When the drug has been taken in one large dose, empty the stomach, and give *tannic acid* (*half a teaspoonful in a glass of water*) as the *chemical antidote*, or, in its absence, *strong tea*, or an infusion of oak bark. Apply heat to the limbs, and keep the patient in the recumbent position. Aconite may be used as the physiological antidote.

**HOLLY BERRIES.**

These berries are eaten with impunity by birds and animals, but upon human beings they act as irritants.

**Symptoms** are those of other irritants—vomiting, purging, cramps, and colic. Unconsciousness may follow.

**Treatment.**—Give emetics and apply heat to the extremities. Stimulate the patient if necessary.

**HYOSCYAMUS.**

(Henbane.)

**Symptoms.**—An overdose of hyoscyamus may produce in some individuals deep sleep and unconsciousness, in others a feeling of excitement and giddiness, followed by noisy delirium and coma. The pupils are dilated and the vision may be double. Thirst is also a prominent symptom.

**Treatment.**—Give emetics, and stimulate if necessary. Strong coffee by the rectum is useful where there is coma. Large doses of castor oil should be given later.

**IODINE.**

**Symptoms.**—There is pain and a burning sensation in the throat, followed by vomiting and purging. The drug leaves a yellow stain about the mouth, and the vomited matter may be dark yellow or blue.

**Treatment.**—*The antidote is starch.* Empty the stomach and give moistened bread or starch and water; thin boiled starch-paste is better if there is time to prepare it. Follow by the use of stimulants and the whites of eggs beaten in milk.

**IODOFORM.**

Iodoform is used as an antiseptic in dressing wounds, and is readily absorbed from cut surfaces. In some susceptible persons, after its prolonged use, very alarming symptoms of poisoning may occur.

**Symptoms** may be mild, consisting only of a feeling of weakness with headache and nausea. In other cases there may be a most severe gastrointestinal irritation. Usually an eruption appears upon the skin in the form of a redness or inflammation. There may be loss of memory, insomnia, and melancholia, or symptoms of great mental excitement, consisting of hallucinations and even mania, may occur.

**Treatment.**—Stop the use of the drug immediately. Then attempt to hasten its elimination by wrapping the patient up in hot blankets or sponging with warm water to produce sweating. Alcoholic stimulants should be given, if necessary.

**LEAD.**

Chronic lead-poisoning is common in painters. Acute poisoning is rare, however, and is generally due to taking paint, red lead, white lead, Goulard's extract, or sugar of lead with suicidal intent.

**Symptoms.**—Lead leaves a sweet, metallic taste in the mouth and a dryness in the throat, soon followed by pain in the abdomen accompanied by vomiting and purging, the vomited matter usually being milk-white in color. The pulse becomes rapid and weak, and the face anxious. There are cramps in the limbs, followed in some cases by convulsions, coma, and death.

**Treatment.**—*The antidote is Epsom or Glauber salts.* Empty the stomach and give the antidote in the dose of one tablespoonful in a glass of water. Follow by the use of the whites of raw eggs and castor oil. Apply heat to the extremities and abdomen.

**MUSHROOMS.**  
(Fly Fungus.)

There are many varieties of mushrooms which are innocuous, while others are extremely dangerous, containing a poison called *muscarine*. It is popularly supposed that a piece of silver or an onion will change color if cooked with a poisonous mushroom, or that cooking mushrooms with vinegar added to the water will destroy the poison. These ideas are fallacious, as no such general rules will apply to all species.

In an excellent article by Porcher in "The Reference Handbook of Medical Sciences", the following rules are given for selecting mushrooms.

1. "Every mushroom should be rejected, whatever its species, which is too old, or with perforations which show the presence of maggots.
2. "All of which the texture is woody.
3. "All those the taste of which is acrid, burning, bitter, acid, or peppery. Although some are edible which are either acrid, or peppery.

4. "All those which exhale a disagreeable and nauseous odor; which are slimy and deliquescent.

5. "The following is an indication of danger: the presence of a bulb or swelling of the base of the stem, it being surrounded by a volva, or white envelope, in the form of an eggshell, and remaining as a socket at the base when the mushroom is pulled up; a collar or ring, large and reflected, or falling back; lastly, the head covered with the *débris* of the volva and made scaly and warty, as in *Amanita muscaria*. In the poisonous, the scales or protuberances rub easily off, leaving the skin intact."

**Symptoms** may come on in a few moments or in several hours, and consist of nausea, vomiting, colic, and diarrhea. The pulse becomes weak; the breathing is labored; the body is covered with a profuse perspiration; the pupils are at first contracted and later dilated. These symptoms are followed by collapse and muscular weakness, and there may be paralysis.

**Treatment.**—Empty the stomach and apply warmth to the abdomen and extremities. Stimulate freely, and later give large doses of castor oil. Atropine may be used as the physiological antidote.

#### OPIUM.

Opium or its active principle, morphine, is present in laudanum, black drop, Dover's powder, paregoric, chlorodyne, and in many soothing-syrups and sleeping-cordials.

**Symptoms.**—The individual experiences a feeling of contentment, which is soon followed by drowsiness and a tendency to fall asleep. The sleep is profound, and, unless aroused, the patient gradually lapses into coma accompanied by such a deadening of the sensibility that it is impossible to awaken him. The skin is pale and moist, or livid; the respirations are labored, noisy, and very slow, often dropping as low as four or five to the minute; the pupils fail to respond to light and are very much contracted, at times as small as pin points. This is one of the characteristic signs of opium poisoning.

Convulsions may precede death, which usually is due to asphyxia.

**Treatment.**—*Potassium permanganate is the chemical antidote.* Empty and wash out the stomach, using a weak solution of potassium permanganate (15 grains of potassium permanganate to a quart of warm water) for the latter purpose, or else give 5 grains of potassium permanganate in a glass of water. Keep the patient aroused by slapping with wet towels, by cold douching, or by giving inhalations of ammonia, and walk him about, if possible. *To allow the patient to sleep is fatal.* Give plenty of strong coffee by the mouth or, if unconscious, by the rectum in an enema. If the breathing becomes labored, perform artificial respiration (page 263). Atropine may be given as the physiological antidote.

**PHENACETIN.**

(See Acetanilid, page 288.)

**PHOSPHORUS.**

Phosphorus is present in matches and some rat-poisons.

**Symptoms.**—It leaves a taste of garlic in the mouth, while the breath has an odor of phosphorus. The symptoms may not come on at once. A sensation of heat and burning is first experienced about the stomach, followed by vomiting, the vomited matter being tinged with blood and appearing luminous in the dark. The pulse becomes weak; the pupils are dilated; and there may be headache, delirium, muscular twitching, and convulsions. Collapse soon follows. Should the sufferer survive, jaundice and hemorrhages from the nose, stomach, and mucous membranes occur.

**Treatment.**—*Potassium permanganate or old French oil of turpentine are antidotes, but any other oils or fats should be avoided, as they aid in the absorption of the poison.* Empty the stomach, and give 5 grains of potassium permanganate in a glass of water, or wash out the stomach with a 1 to 1000 solution of potassium permanganate (15 grains of potassium permanganate to a quart of water), then follow by giving mucilaginous drinks.

**POKE BERRIES.**  
(*Phytolacca* Fruit.)

**Symptoms.**—In small doses they act as irritants, producing nausea, vomiting, and purging. In large doses they have a narcotic action which is slow and protracted. Convulsions and coma may occur.

**Treatment.**—Empty the stomach and give castor oil; follow by mucilaginous drinks; stimulate if necessary.

**PTOMAINES.**  
(Food Poisoning.)

During the putrefaction of animal and vegetable matter, certain injurious substances, called *ptomaines*, are produced which give rise to serious symptoms if taken into the system. Poisoning from eating tainted meat, fish, lobsters, clams, milk, and cheese are included under this head.

**Symptoms.**—Usually a few hours after taking the food there is a feeling of nausea followed by retching, vomiting, abdominal pain, and faintness. Purging may also occur. Marked prostration, manifested by a cold, moist skin and weak pulse, soon follows. The pupils are dilated. Thirst and muscular weakness are prominent symptoms, and even convulsions and delirium may occur. In some individuals a redness of the skin or a scarlet rash is produced.

**Treatment.**—Empty the stomach, give stimulants, and apply heat to the abdomen and extremities. Later, give a large dose of castor oil.

**SILVER NITRATE.**  
(Lunar Caustic.)

Acute poisoning is rare, but it has occurred from sticks of silver nitrate being broken off and swallowed during cauterization of the throat.

**Symptoms** are those of a corrosive—pain and burning in the throat and abdomen, and gastrointestinal irritation. The mouth will be stained white.

**Treatment.**—*Salt is the antidote.* Give emetics, followed by salt and water (one tablepoonful of salt to a glass of water).

**STRAMONIUM.**

(Thornapple, Stink Weed, Jamestown Weed.)

Stramonium resembles belladonna in its action and the symptoms it produces. (See Belladonna, page 293.)

**STRYCHNINE, NUX VOMICA.**

(Poison Nut, Dog Button, Quaker Button.)

Strychnine is the active principle of nux vomica, it is also present in St. Ignatius bean.

**Symptoms.**—The effect of the poison may be manifested by a sudden spasm of the muscles which throws the individual off his feet, or there may first be a feeling of suffocation, difficulty in breathing, and a sensation of stiffness about the neck. This is soon followed by convulsions affecting nearly all the muscles at once. The head is drawn back and the body is held rigidly arched forward, so that the sufferer practically rests upon his head and his heels; the eyes are open and staring; the corners of the mouth are drawn back, giving an appearance of laughing (*risus sardonicus*). During the convulsions there is great difficulty or even inability to breathe. A convulsion will last a few moments and then pass off, leaving the sufferer weak and exhausted; the slightest noise or touch is liable to bring on another convulsion. Eventually the convulsions follow one another in rapid succession, and death results from asphyxia or exhaustion.

Strychnine-poisoning resembles lock-jaw (tetanus), but can be distinguished from it by the fact that in tetanus there is rarely any complete muscular relaxation, while in strychnine-poisoning there is a distinct period of intermission between the convulsions. Again, in tetanus locking of the jaws is one of the early symptoms; in strychnine-poisoning it comes late.

**Treatment.**—*Tannin or charcoal are the antidotes.* If the sufferer is seen early, before the convulsions occur, empty the stomach and give tannic acid (half a teaspoonful of tannic acid in a glass of water), charcoal, *strong* tea, or an infusion of oak bark. Inhalations of amyl nitrite or chloroform should be given to control the convulsions, while large doses of chloral

and bromides should be given by the rectum. It may be necessary to perform artificial respiration (page 263).

#### TOBACCO, NICOTINE.

Nicotine, the active principle of tobacco, will produce poisoning if taken internally.

**Symptoms.**—The symptoms are those of gastrointestinal irritation with those of collapse. There is a burning sensation in the mouth, throat, and abdomen, followed by nausea and vomiting; the pulse is rapid and feeble; the respirations are labored; the pupils are contracted. Intense muscular weakness, convulsions, and coma rapidly follow.

**Treatment.**—Employ emetics or the stomach-pump; *give tannic acid* (in the dose of half a teaspoonful to a glass of water) *as an antidote*, or in its absence *strong tea* or an infusion of oak bark; keep the patient in a recumbent position, and apply heat to the abdomen and extremities. As the physiological antidote, strychnine may be employed. Perform artificial respiration (page 263) if needed.

#### UNKNOWN POISON.

If possible empty the stomach by producing vomiting. Then give mucilaginous drinks, as eggs beaten in milk, flaxseed tea, olive oil, etc. Stimulants should be given if required and in the presence of collapse, heat should be applied to the heart and extremities.

When the exact nature of the poison is not known a combination of several substances which will neutralize a number of different poisons may be given as an antidote. The following is frequently employed: powdered charcoal 2 parts, tannic acid 1 part, and magnesia 1 part. Give a heaping teaspoonful in a glass of water.

#### WOOD ALCOHOL.

(Methyl-alcohol, Columbian Spirits, Pyroligneous Spirits, Wood Naphtha.)

**Symptoms.**—The symptoms are those of excitement, exhilaration, and intoxication. These are followed by head-



ache, nausea and long continued vomiting, and collapse. Convulsions may be present. The pupils are usually dilated and the body is covered with perspiration.

**Treatment.**—Empty the stomach. Apply heat to the heart and extremities and give stimulants, such as inhalations of ammonia, strychnine, or strong coffee by the rectum.

#### ZINC.

Zinc salts, as the sulphate (white vitriol) and the chloride (butter of zinc), are extremely poisonous in large doses. Certain soldering fluids also contain zinc.

**Symptoms.**—It is an irritant in its action, producing pain and burning of the throat and abdomen, vomiting, purging, colicky pains, and collapse.

**Treatment.**—Empty the stomach, and give bicarbonate of soda, the whites of eggs, strong tea, or tannic acid (half a teaspoonful in a glass of water). Apply heat to the abdomen and limbs, and stimulate if need be.

For hasty reference the following résumé of the immediate treatment in cases of poisoning is given:

POISON.	TREATMENT.
<i>Acetanilid</i> .....	Empty the stomach, keep patient lying quiet. Give stimulants and employ artificial respiration if breathing fails.
<i>Acids</i> .....	<i>Alkalies are antidotes.</i> Give chalk, lime-water, magnesia, etc. Follow by mucilaginous drinks. Give stimulants if necessary, and opiates for pain.
<i>Aconite</i> .....	Empty the stomach. <i>Give tannic acid or strong tea as antidotes.</i> Stimulate freely. Keep the patient quiet.
<i>Alcohol</i> .....	Empty the stomach and arouse the patient by cold douching.
<i>Alkalies</i> .....	<i>Weak acids are antidotes.</i> Give lemon-juice, orange-juice, vinegar, etc. Follow by mucilaginous drinks. Stimulate if necessary, and give opiates for pain.
<i>Antimony</i> .....	Empty the stomach. <i>Tannic acid, gallic acid, or strong tea are antidotes.</i> Stimulate freely.
<i>Antipyrine</i> .....	Same as acetanilid.
<i>Arsenic</i> .....	Empty the stomach. <i>Raw whites of eggs beaten in milk, precipitated ferric hydrate or magnesia are antidotes.</i> Follow by mucilaginous drinks, stimulation, and opiates.

POISON.	TREATMENT.
<i>Belladonna</i> .....	Empty the stomach and stimulate.
<i>Camphor</i> .....	Empty the stomach and stimulate.
<i>Cannabis indica</i> .....	Empty the stomach and keep the patient aroused.
<i>Cantharides</i> .....	Empty the stomach. Follow by mucilaginous drinks. Give opiates for pain.
<i>Carbolic acid</i> .....	<i>Alcohol, Epsom or Glauber Salts are antidotes.</i> Later, give mucilaginous drinks and stimulate freely.
<i>Chloral</i> .....	Empty the stomach. Stimulate, and keep the patient aroused. Perform artificial respiration if necessary.
<i>Chloroform</i> (taken internally).....	Empty the stomach and try to arouse.
<i>Chloroform, ether, and nitrous oxide</i> (inhaled).....	Place the head low and the feet raised. Perform artificial respiration and stimulate.
<i>Cocaine</i> .....	If taken by mouth empty the stomach. Apply heat to the heart and extremities and give stimulants. Morphine should be given as the physiological antidote.
<i>Colchicum</i> .....	Empty the stomach. <i>Tannic acid or strong tea are antidotes.</i> Later, give mucilaginous drinks, and stimulate.
<i>Conium</i> .....	Empty the stomach. Give tannic acid or strong tea, and stimulate.
<i>Copper</i> .....	Empty the stomach. <i>Potassium ferrocyanide and whites of eggs are antidotes.</i> Follow by mucilaginous drinks.
<i>Corrosive sublimate</i> .....	Empty the stomach. <i>The whites of eggs act as an antidote.</i> Follow by mucilaginous drinks and stimulation.
<i>Croton oil</i> .....	Empty the stomach. Give mucilaginous drinks, and stimulate.
<i>Digitalis</i> .....	Empty the stomach. <i>Tannic acid or strong tea are antidotes.</i>
<i>Holly berries</i> .....	Empty the stomach and stimulate.
<i>Hydrocyanic acid</i> .....	Empty the stomach. Employ artificial respiration and stimulate freely.
<i>Hyoscyamus</i> .....	Empty the stomach, stimulate, and keep aroused.
<i>Iodine</i> .....	Empty the stomach. <i>Starch is an antidote.</i>
<i>Iodoform</i> (externally).....	Stop the use of the drug and hasten its elimination by profuse sweating.
<i>Lead</i> .....	Empty the stomach. <i>Epsom or Glauber salts are antidotes.</i> Follow by the use of mucilaginous drinks.
<i>Mushrooms</i> .....	Empty the stomach and stimulate freely.
<i>Opium</i> .....	Empty the stomach. <i>Potassium permanganate is an antidote.</i> Keep the patient aroused, stimulate, and perform artificial respiration if necessary.
<i>Phenacetin</i> .....	Same as for acetanilid.
<i>Phosphorus</i> .....	Empty the stomach. <i>Potassium permanganate or old French oil of turpentine are antidotes.</i> Use no other oils. Follow by mucilaginous drinks.

POISON.	TREATMENT.
<i>Poke berries</i> .....	Empty the stomach, stimulate, and give mucilaginous drinks.
<i>Plomaine</i> .....	Empty the stomach and stimulate.
<i>Silver nitrate</i> .....	Empty the stomach. <i>Salt is an antidote.</i>
<i>Stramonium</i> .....	Empty the stomach and stimulate.
<i>Strychnine</i> .....	Empty the stomach. <i>Tannic acid, strong tea, or charcoal are antidotes.</i> Perform artificial respiration if necessary.
<i>Tobacco</i> .....	Empty the stomach. <i>Tannic acid or strong tea are antidotes.</i>
<i>Unknown poison</i> .....	Empty the stomach. Give mucilaginous drinks. Stimulate and apply heat to the heart and extremities.
<i>Wood alcohol</i> .....	Empty the stomach. Apply heat to the heart and extremities and give stimulants.
<i>Zinc</i> .....	Empty the stomach. Give <i>strong tea, tannic acid, or bicarbonate of soda.</i> Follow by mucilaginous drinks and stimulation.

## CHAPTER XXI.

### THE TRANSPORTATION OF THE INJURED.

The removal of a disabled person to his home, or to a place where he may be properly cared for, plays a considerable part in his immediate care. While human ingenuity may always find some means for accomplishing this in an emergency, yet, unless a person has some practical knowledge of the methods which can be used, it will usually be done in such a clumsy manner as to be exceedingly uncomfortable, if not actually harmful, for the sufferer. Every one who has seen accidents can recall occasions where a familiarity with the subject would have been of great assistance. In large towns or cities there are plenty of ambulances within call, and the duties of a "first-aider" end when he has rendered what assistance is possible. In the country, however, accidents may occur miles from help, with no vehicle available for transportation. To be alone with a disabled person far from any aid is a serious situation for any one, and the question of how to move him becomes a most troublesome problem, especially if the roads are rough or the country is mountainous.

The means of transportation may be divided into removal by hand, by chairs, on a stretcher, on a wheeled litter, by animals, or by ambulance, cart, or wagon, the choice of one method over the other depending upon the distance to be traveled and the help and apparatus available.

#### REMOVAL BY HAND.

**By means of a single bearer** (when the person is conscious and able to assist).

(1) **Simply Assisting the Patient to Walk.**—If the person is suffering from only a slight injury which does not involve

the lower limbs—as a fracture of the upper extremity or simply weakness—stand upon one side of him and place your shoulder under his armpit, drawing his arm up over your shoulder, behind your neck, and across the opposite shoulder. His wrist is held in this position with the hand of the same side, while the arm nearest the patient encircles his waist (Fig. 220). In this way he may be assisted to walk, his whole weight being



FIG. 220.—Method of assisting an injured person to walk.

supported should he stumble or fall. A person with a sprained ankle may be assisted in the above manner by supporting him upon the injured side and having him hop along without placing the injured foot upon the ground.

(2) **Carrying Pick-a-back.**—The patient stands up behind the bearer with one or both arms over the bearer's shoulders. The bearer then stoops down and, passing both arms behind him, grasps the patient's thighs firmly, drawing them forward one on each side of his body; he then raises up and shifts him well up on his back. A person may be comfortably carried a long

distance in this manner if his arms are uninjured and he can partly support himself by holding on to the bearer's shoulders.

(3) **Carrying in the arms** is a method only of use for moving a person a short distance or where the individual is not very heavy. The patient stands up, the bearer taking his position behind and supporting him. The bearer, stooping slightly, places one arm about the patient's waist and the other under his thighs and raises him to a sitting position in the arms, the patient aiding by clasping one or both arms about the bearer's neck.

**By means of a single bearer** (the patient being unconscious or helpless).

(1) **Carrying Pick-a-back.**—A helpless person can be carried by this method only when there is help enough to place him upon the bearer's back. Lifted into the proper position, the patient is securely fastened in place by a rope, several straps or belts buckled together, or by a sheet, which passes around his back, under his arms, and up over the bearer's shoulders. It then crosses over the front of the bearer's chest, and passes around under his arms to the patient's back, where the ends are secured.

(2) **Carrying in the Arms.**—The bearer supports the patient in a sitting position, and, kneeling beside him, places



FIG. 221.—Raising an unconscious or helpless person from the ground.

one arm about his waist and the other under his thighs. Then, by raising up, he lifts the patient into his arms. This method of lifting, however, is only possible when the person is not heavy. An ordinary man could not raise a heavy person more than a few inches from the ground in this manner. For the majority of cases the following method will have to be employed:

First, turn the patient flat on his face upon the ground; then, stepping astride his body and facing toward his head, place the hands under his armpits and lift into a kneeling position (Fig. 221). The hands should now be quickly slid



FIG. 222.—Lifting into the arms.

down under the patient's abdomen, when he can be raised to his feet. The bearer should support the patient in the erect position and place himself so that his left side will be toward the patient's right, with the patient's right arm falling about his neck. To lift into the arms, the bearer stoops down, passes his left arm around the patient's waist, places his right arm beneath his thighs, and, straightening up, lifts him into his arms (Fig 222).

(3) **Carrying with the Patient Across the Bearer's Back.**—The patient is raised to a standing position as described above. The bearer then shifts himself to the front of the patient and with his left hand firmly

grasps the patient's right hand, drawing the arm around his neck, over his left shoulder, and down across his chest. Then



FIG. 223.—Method of lifting across the back.



FIG. 224.—Carrying with the patient across the back.

stooping over, the bearer encircles the patient's thighs or the right thigh, if both cannot be managed, with his right arm and, at the same time, seizes the patient's right wrist with the same hand (Fig. 223). With his left hand, which is now free, the bearer seizes the patient's left wrist. On rising, the patient's body will fall across the bearer's back (Fig. 224).

(4) **Carrying with the Patient Across the Shoulder.**—This method has an advantage over the others in that it leaves one of the bearer's hands free, a matter of great importance if obstacles have to be crossed or a ladder mounted. It is



FIG. 225.—Raising a helpless person from the ground preparatory to lifting across the shoulder.

sometimes spoken of as the "fireman's lift," because used by them in carrying an unconscious person from a burning building.

In lifting by this method, the bearer turns the patient face downward as before, but now places himself at the patient's head, facing him. He passes his hands under the patient's armpits and lifts him to his knees (Fig. 225). The hands should then be shifted lower down and clasped behind the patient's back. With this grip the patient may be raised to a standing position. The bearer supports the patient while he stoops down and places himself so that his right shoulder comes under the patient's abdomen, the upper part of the



patient's body lying over the shoulder. The bearer then grasps the patient's right wrist in his left hand and brings it down and around under his left arm from behind, while he passes his right arm around the two thighs, if it be a woman with



FIG. 226.—Method of lifting across the shoulder.



FIG. 227.—Carrying with the patient across the shoulder, the bearer's left arm being free.

skirts, or, if it be a man, simply around the right thigh (Fig. 226), and then shifts the patient's right hand so that it is clasped by the hand which encircles the thighs. The bearer then rises. By this method the patient will be securely held over the bearer's right shoulder, and the bearer's left arm will be entirely free (Fig. 227).

**By Means of Two Bearers. (1) The Two-handed Seat.—**

The two bearers kneel upon opposite sides of the patient near his hips, and raise him to a sitting position. Each then passes one arm around the patient's back and the other under his thighs, the bearer on the patient's right grasping with his right hand the left wrist of his companion, the bearer on the left grasping with his left hand the right wrist of the first bearer. Both then rise slowly from the ground, and may shift their

disengaged hands to each other's shoulders, thus forming a back rest for the patient; or, unless helpless, the patient may support himself by placing an arm around the neck of each bearer (Fig. 228).

(2) **The Three-handed Seat.**

The two bearers stand upon opposite sides of the patient. One of them—the bearer upon the patient's right, for example—grasps with his right hand his own left wrist, and with his left hand the left wrist of the other bearer. The bearer on the left grasps with his left hand the right wrist of the first bearer (Fig. 229), and with his

disengaged right hand grasps the first bearer's shoulder, thus forming a rest for the patient. Both bearers stoop down and slip the seat under the patient, he assisting by placing an arm



FIG. 228.—Carrying by the two-handed seat.



FIG. 229.—Three-handed seat.



FIG. 230.—Four-handed seat.

about the neck of each and raising himself up while the seat is being placed under him. This method is not applicable to patients who are helpless or unconscious.

(3) **The Four-handed Seat.**—Each bearer takes his position as before, grasping his own left wrist with his right hand and his partner's right wrist with his left hand (Fig. 230). The patient sits or is placed upon the seat thus formed, and must support himself by encircling each bearer's neck with one arm.



FIG. 231.—Carrying by the extremities.

It is not suitable for patients with injuries about the upper extremities.

(4) **Carrying by the Extremities.**—One bearer takes his place at the patient's head and raises him to a sitting posture. He then passes his arms under the patient's armpits, clasping his hands in front over the chest. The other bearer takes his position between the patient's thighs, grasping one thigh just

above the knee in each arm. Both should rise together, lifting the patient into a horizontal position (Fig. 231). This is a good method for transporting very weak persons without a stretcher.

(5) **Improvised Seats.**—In cases when a patient has to be carried a considerable distance, the hands of the bearers soon become tired and cramped when employing the above methods. To avoid this, a seat may readily be improvised from a board, or from a rope, straps, towels, bandages, or other material tied in the form of a ring, upon which the patient sits, it being held

by a bearer on each side. If the patient can assist in supporting himself, the bearers carry the seat with the hands nearest the patient; otherwise, they use the outer hands, their free hands supporting the patient.

Another form of seat may be made by cutting two poles, each about four feet long, and fastening to them two broad strips of any strong material at a distance of about one and a half feet from each other. The patient sits upon this seat with his legs hanging over the side poles and his back resting against the rear bearer.

#### REMOVAL ON CHAIRS.

By substituting a chair for the hand-seat, a person may be moved (by two bearers) in a sitting or semirecumbent position far more comfortably for both bearers and patient. Any strong chair will do.

Having placed the patient in the chair, the two bearers stand at either side and, stooping down, grasp the front legs or lower rungs with one hand and the back of the chair with the other. They then rise together, tipping the chair backward somewhat so as to distribute the weight more evenly between the two arms. In carrying a loaded chair upstairs always have the back go first.

#### REMOVAL ON STRETCHERS.

A stretcher is simply a light form of bed for transporting a disabled person who, from the character of his injuries, or on account of his condition, must remain in a recumbent position. Usually two bearers are all that are needed for carrying the stretcher—one to bear the head end and one to bear the foot, though in some cases one or two extra persons may be required to watch the patient or aid the others in carrying.

There are any number of different kinds of stretchers manufactured, but the principles upon which they are constructed are in the main the same. All stretchers should be light, strong, and of such construction as will permit them to be

easily folded when not in use, and also allow them to be readily cleaned.

The following description should give an idea of what is required: The frame work consists of two poles, each seven and a half to eight feet long, which are square except at the extremities, where they are rounded off to form handles. The two poles are kept the proper distance apart—about twenty-two inches—by means of transverse iron braces placed near either end. These crossbraces consist of two pieces joined in the center to form a scissors-like joint, which closes inward to allow the poles to be drawn together and the stretcher to be folded when not in use. Between the poles is stretched a width

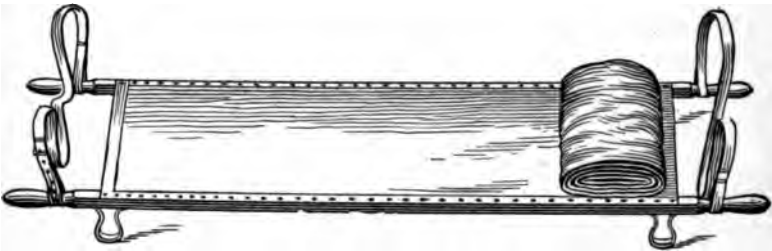


FIG. 232.—The Army stretcher (opened).

of canvas six feet long, which forms the stretcher bed. The stretcher is supported upon four legs, each about four inches high, made from iron or from round pegs of wood which are screwed into the poles. Beneath the canvas and stretching between the two poles at either end are two narrow straps which are used to fasten the stretcher poles together when folded up and not in use. In some cases, as with the army stretchers, slings are provided which pass over the bearer's shoulder and help to take some of the weight from the arms. Each sling consists of a strong piece of webbing or a leather strap about two inches wide, with a loop at each end through which the handles pass; one of these loops is supplied with a buckle so that the length of the sling may be regulated to fit the bearer.

To put away or fold such a stretcher the transverse pieces are broken inward and the poles pushed together, the canvas

bedding being raised from between them. The canvas should then be tightly rolled around the poles, the slings laid on top, and the whole affair securely fastened by passing the small straps previously mentioned around the poles and through the loops of the slings (Fig. 233).

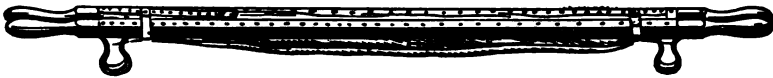


FIG. 233.—The Army stretcher (closed).

**Improvised Stretchers.**—With the above description of what is required for a stretcher in mind, it should not be a difficult matter for anyone to contrive some sort of an affair, should the circumstances demand it. Some of the many stretchers that may be improvised are made as follows:

**The Blanket Stretcher.**—Two strong poles should be cut to the proper length—narrow fence-rails, limbs of trees, or small saplings will answer; a blanket or rug is then placed

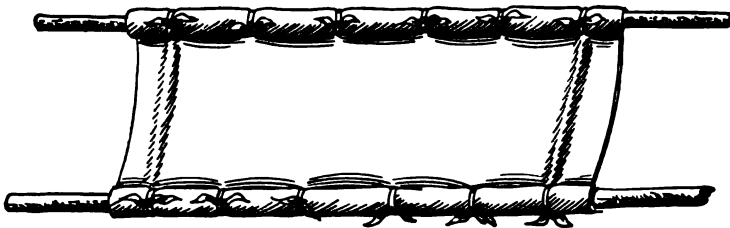


FIG. 234.—A blanket stretcher.

upon the ground, and the poles are rolled from each side in the edges of the blanket until the portion remaining unrolled is of sufficient width for a stretcher bed. The stretcher may be made more secure by wrapping cords about that portion of the blanket surrounding the poles, the cords passing through holes made in the blanket along the inner edges near the poles. Two sticks or pieces of board should be fastened at either end of the stretcher bed to hold the stretcher poles the proper distance apart (Fig. 234).

The **sack stretcher** is made by using two sacks for the stretcher bed—grain sacks, potato sacks, or strong pillow-cases will answer. The poles pass in at the mouths of the sacks and on out through holes cut in the bottom corners.

The **coat stretcher** may be made from two or three coats or vests, or from a single large overcoat. The sleeves of the coats are turned inside out, and through them are passed the two

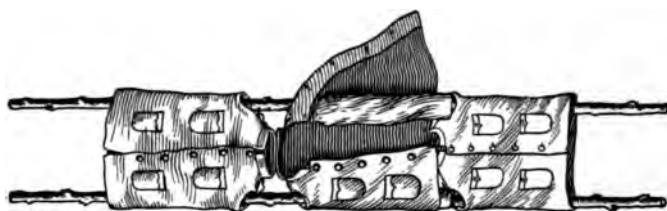


FIG. 235.—Stretcher improvised from coats (inverted to show the manner in which it is made).

poles. The flaps of the coats are then turned down around the poles and buttoned underneath (Fig. 235).

**Gun Stretchers.**—Instead of poles the framework of a stretcher may be improvised from two shotguns or rifles, any of the above materials being utilized for the stretcher bed. The muzzles of both guns should point in the same direction, the trigger guards being uppermost. Of course, a loaded gun or one with cartridges in the magazine should never be used.

**Hammock Stretchers.**—A hammock, if available, is an excellent form of stretcher. The two ends of the hammock are fastened to a long pole which is carried upon the shoulders of two bearers.

In addition to the above, benches, tables, mattresses, window-shutters, doors, and boards may be employed as stretchers. To form a stretcher bed, where the materials already suggested cannot be obtained, ropes, cords, wire, straps, suspenders, belts, or bandages may be interlaced between poles or guns and covered with straw or hay.

**To Lift an Injured Person on to a Stretcher.**—Before

attempting to remove an injured person always perform the necessary first-aid treatment, such as stopping hemorrhage, dressing wounds, putting on splints, etc. And remember to handle the patient with extreme care and gentleness. Never lift a person with a fractured limb from the ground unless the limb is supported in such a manner that no strain will be thrown upon the broken fragments. The stretcher should, if possible, be placed at a short distance from the head of the patient in line with his body; if space will not permit of this, it may be laid down beside the patient.

(1) **To Lift with Two Bearers.**—The bearers take their positions upon the injured side of the patient, one at his hips and one at his knees. The first one then inserts his hands beneath the patient's shoulders and back, while the second one passes his arms beneath the thighs and calves. They should both rise together and carry the patient over the foot of the stretcher, head first.

When the stretcher has to be placed at the patient's side, the bearers take positions at the head and feet of the patient. The first one stoops down and passes his arms around the patient's chest and under his shoulders, firmly locking the fingers. The second bearer takes his place at the patient's knees, passing his arms around the thighs just above the knees. Both then rise together and transfer the patient to the stretcher.

(2) **To Lift with Three Bearers.**—Two of the bearers kneel on one side of the patient, one passing his hands and arms beneath the patient's shoulders and back, the other beneath the calves and ankles. The third bearer places himself upon the opposite side, supporting the patient's thighs and back. All three bearers rise together and transfer the patient to the stretcher, head first over its foot; or the patient is lifted by all three bearers, and, while supported upon the knees of the two who are upon the same side, the third bearer gets the stretcher and places it in position beneath the patient.

(3) **To Lift with Four Bearers.**—Three bearers kneel on the same side of the patient. The first passes one arm



beneath the patient's shoulders, the other arm supporting his neck; the second passes his arms beneath the back and thighs; the third passes one arm beneath the calves and one under the ankles. The fourth bearer kneels down upon the opposite side, passing his arms beneath the patient's back and thighs. All lift together and place the patient upon the knees of the first three, while the fourth bearer brings the stretcher and carefully inserts it beneath the patient.

Instead of the above maneuver, two bearers kneel upon each side of the patient, facing each other. Two pass their hands beneath the patient's shoulders and back, and the other two beneath the thighs and calves, the opposed bearers interlocking their fingers. They then rise together and transfer the patient to the stretcher. In unloading, the maneuvers are to be reversed in all cases.

**To Lift an Injured Person from Stretcher to Bed.**—If the bed is narrow, the stretcher may be placed at its foot, head first. The bearers then arrange themselves, according to the number, in the manner described above, and lift the patient, carrying him head first over the foot of the bed.

If the bed is too wide for the bearer to carry the patient over its foot or if there is not sufficient room to place the stretcher in line with the bed, it may be placed at the side. The patient is then lifted, with two or three bearers upon the side farthest from the bed and one bearer upon the opposite side, as described above; and, while he is supported upon the knees of the bearers who are upon the same side, the extra bearer removes the stretcher and steps aside, allowing the others to place the patient upon the bed.

**Carrying the Stretcher.**—In transporting a disabled person upon a stretcher there are certain rules to be observed for the comfort and safety of the patient.

As a general rule the patient should lie upon the stretcher with the feet pointing in the direction to be traveled. If a person is faint or suffering from shock or collapse, have the head lower than the feet; with an injury accompanied by great

difficulty in breathing, however, the head and chest should be slightly elevated.

Always keep the stretcher as near the ground as possible, carrying it at arm's length. It should never be carried upon the shoulders of the bearers, for, should they stumble, the patient might receive a dangerous fall.

Walk out of step to avoid swinging the stretcher, which jars the patient. For the same reason, and because the patient might be thrown off, never run with a loaded stretcher.

Have the stretcher kept as nearly level as possible. In ascending or descending a hill or incline, the front bearer (if descending) or the rear bearer (if ascending) should raise his end sufficiently to keep the stretcher on a level. The head of the stretcher should never be lower than the feet except in a fracture of the lower extremity or in the conditions mentioned above, and for this reason the tallest bearer, and likewise the strongest, should always carry the head end, as this end is the heaviest. In lifting the loaded stretcher from the ground, raise the head end slightly in advance of the foot.

With the lower extremity fractured, place the patient upon his back on the stretcher. Carry feet foremost in going uphill and head first downhill to prevent the weight of the body by any chance pressing down upon the injured limb.

Do not attempt to cross a ditch, stream, wall, or fence with a loaded stretcher if it can be avoided. Rather tear down the obstacle, or even make a longer journey if necessary. In any case it is dangerous to try to cross any obstacle without at least three or, better still, four bearers, the extra ones standing beside the stretcher to assist in elevating or lowering it, and at the same time to prevent the patient from falling off.

If it is necessary to cross a fence or wall—and it should not be attempted if the obstacle is over seven feet—the extra bearers stand beside the stretcher if the obstacle is low and assist in elevating it sufficiently to place the foremost end upon the top of the obstacle. The stretcher is maintained in this position, the extra bearers aiding the rear bearer in supporting it until

the front bearer climbs the obstacle and takes hold of the foremost end. The extra bearers then climb the obstacle and the stretcher is carried forward until the rear end rests upon the top of the obstacle. The rear bearer finally climbs over and the stretcher again advances. An obstacle may be crossed by the same maneuver, using two bearers at each end of the stretcher instead of any assistance from the sides (Fig. 236). This latter method should be used in crossing high fences or walls.

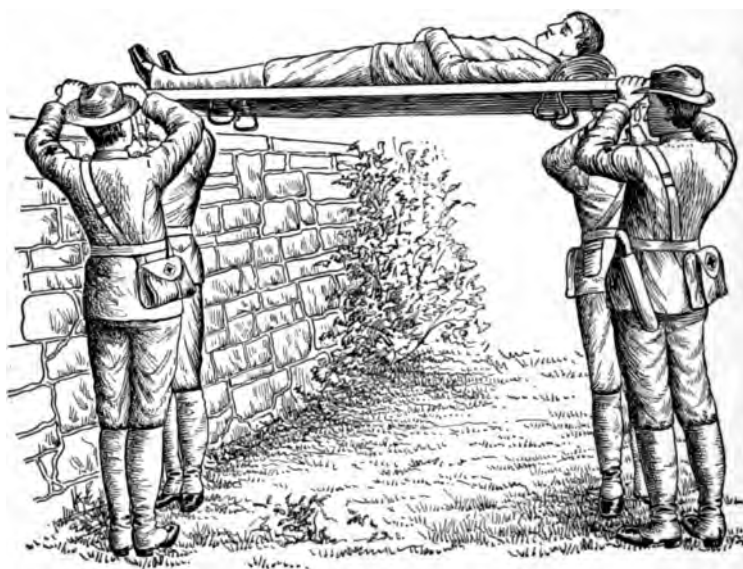


FIG. 236.—Method of crossing a high fence or wall.

In crossing a ditch or stream, the stretcher is laid upon the ground with its foot near the edge. If the distance is not wide, the two front bearers enter the ditch or stream and, aided by the other bearers, carry the foremost end of the stretcher to the opposite side. The two first bearers then get out of the ditch and take care of the front end of the stretcher, while the rear bearers enter the ditch and help to lift the stretcher to the opposite bank. The rear bearers then leave the ditch and again take up the rear of the stretcher. If the distance to

be crossed is very wide, the two first bearers enter the ditch and the stretcher is advanced as before until its rear end rests upon the bank, the front end being supported by the first bearers. The two rear bearers then enter the ditch, and the stretcher is advanced to the opposite bank, upon which the foremost end is placed. The two first bearers then climb out and take hold of the front handles of the stretcher, while the rear is held by the rear bearers. The remaining maneuvers are the same as for crossing a narrow ditch or stream.

A stretcher should be carried upstairs head first. One bearer supports the front end, while two hold up the rear end, raising it high enough to keep the stretcher on a level. A fourth bearer should remain at the side of the patient to prevent him from falling off. In descending stairs, the foot of the stretcher is carried first and the positions of the bearers are reversed, that is, two bearers support the front end and one the rear.

**To Raise or Lower a Stretcher where it is Impossible to Use Bearers.**—At times it is necessary to move a person up the side of a steep cliff, up the side of a ship, or out of an excavation, mine, or well. In an emergency, without suitable apparatus, a sling can be improvised by means of which the stretcher may be readily raised or lowered from above. Strong ropes are fastened to the four corners of the stretcher frame, converging toward each other and meeting at a point several feet above the stretcher. A supporting rope by which the stretcher is to be raised or lowered, or, better still, a pulley through which this rope can pass, is secured to the rope sling at a point that will keep the loaded stretcher level when raised. The bed of the stretcher should be longer than ordinarily required—at least seven feet long—and the patient should be securely fastened to it, so that he will not fall out, even though the stretcher be turned on end. For this purpose a strong piece of blanket, canvas, or a folded sheet should be passed across his body and secured to the stretcher poles, firmly binding him to the stretcher. In like manner the shoulders

should be strapped down and the legs securely fastened by strips passing around the thighs and ankles (Fig. 237.) In all cases plenty of help will be needed to raise or lower the stretcher.



FIG. 237.—Raising an injured person up a cliff.

If it is necessary to raise a person through a narrow opening, he may be securely fastened to the stretcher as described above and raised in an upright position, the feet being lowermost. For lowering or raising an injured person through ship

hatches, a special stretcher, known as Gihon's cot (Fig. 238), has been devised. Should the condition of the patient be such that he can remain sitting up, a seat or strong chair may be fitted with a sling, and the patient be raised or lowered in a more comfortable manner.

#### REMOVAL ON WHEELED LITTERS.

A wheeled litter is simply a stretcher on wheels to be pushed or pulled by a single bearer. The litter usually consists of a hand stretcher mounted upon a light frame, which is supported upon wheels. Springs should always be provided, and props should be fastened at each end, which can be lowered and so support the litter when standing alone. The stretcher must be built in such a manner that it can be removed and replaced at will, because the patient should never be lifted from the ground to the litter. Instead, the stretcher should be placed beside the patient and, when loaded, replaced upon the frame. In an emergency, a wheelbarrow is sometimes utilized for the same purposes.

Wheeled litters are of no practical value in a rough country; they can only be used upon smooth roads. They are, however, frequently used in small towns which do not possess ambulances, and for this reason have been mentioned.



FIG. 238.—Gihon's cot for ship's use; patient ready to be lowered through a hatch or into a boat.

supplied with stretchers, necessary drugs, dressings, splints, and surgical appliances. For use in large cities where the roadways are good and where it is usually necessary to transport but a single patient at a time, the ambulance is constructed with the idea of providing a light and easy-running vehicle, which at the same time will permit of speed. As a rule they are drawn by one horse and are capable of comfortably carrying but one person in a recumbent position, but with crowding may accommodate two. The wheels of many of the modern ambulances are fitted up with ball bearings and rubber tires.

At one time the light ambulance was tried in the Army but proved unsatisfactory. Over rough roads there was too much jolting for the patients, and the vehicles did not last long. At the present time a much heavier, larger, and stronger vehicle is used, requiring at least two horses to draw it. It has room enough to accommodate two patients recumbent and several more sitting. Being provided with strong, stout springs, it is well adapted for rough country.

Whenever it becomes necessary to transport a person in an ordinary wagon or cart, obtain one large enough to accommodate the patient without cramping him, preferably a vehicle with springs. *Never attempt to move a person suffering from a fracture of the lower limbs in a hansom or cab.* He should have enough room to keep the injured limb extended. To furnish a certain amount of springiness in a wagon not supplied with springs, a number of thin boards or elastic poles should be placed across the top of the wagon or cart-body. Slender green saplings will answer for this purpose. Upon the top of these improvised springs is placed the stretcher, securely lashed to the wagon body. Where nothing better can be obtained, the floor of the wagon or cart may be covered with hay, straw, leaves, or boughs upon which the stretcher rests. If this is done jars or jolts will not be felt with as much force by the patient.

**To Lift a Stretcher into a Vehicle.**—The stretcher should always be loaded into the back of the vehicle, not lifted side-

ways over the wheels. As a rule, the head should go foremost, unless the vehicle is lower in front than behind. Two bearers place themselves on each side of the head of the stretcher and two grasp the foot, and all lifting together place the head of the stretcher in the vehicle. One bearer now gets into the vehicle and takes hold of the front end, another supports the rear, and the other two stand upon the sides of the stretcher grasping the two poles. All lift together and advance the stretcher into the vehicle.

In removing a stretcher, the above order of proceeding is simply reversed.



## CHAPTER XXII.

### PREPARATION IN THE HOUSE FOR AN ACCIDENT CASE.

Before an individual, suddenly taken sick or injured, is removed to his home, the family should be notified by a messenger sent on in advance so that some preparations may be begun for the comfort of the sufferer. The sudden arrival of an injured person at his home without any warning is an unnecessary shock to the family, and frequently throws the household into such a state of excitement that no intelligent aid can be rendered and much valuable time may be lost. Always give some definite information as to the nature of the injuries, *and never summon a doctor without stating what sort of a case he is to treat*, so that he may come properly prepared.

**Things Usually Needed.**—The following supplies should be prepared in readiness for any case of sudden injury—namely, plenty of hot and cold water; one or two bowls or dishes; a slop pail for dirty water; soap; a scrubbing brush for the hands; clean towels; sheets; and some whiskey or brandy. There should be provided in addition:

*For hemorrhage*, boiling water, sponges, clean linen or gauze and bandages.

*For fractures*, plenty of cotton, splints or some material from which they can be made, bandages, and adhesive plaster.

*For burns*, olive oil, lard, vaseline, or carron oil, clean linen or lint, and bandages.

*For shock*, hot water bags or bottles, and warm blankets.

*For sunstroke*, plenty of cold water and ice.

**The Sick Room.**—The room which a sick person is to occupy should be selected with some forethought for the patient's comfort. Choose a room in some part of the house

away from all noise, yet easily accessible—preferably a room which has a southern exposure, so that the patient can have the benefit of the sunshine.

The room should be larger than would be necessary for an ordinary sleeping apartment, because there are usually one or more persons present besides the patient himself to consume the oxygen from the air. Bare floors are much cleaner than carpets, and for the same reason curtains, fabrics, hangings about the bed, all unnecessary furniture, and, in fact, anything that is liable to collect dust, should be removed. The room should be kept at an even temperature—about 65° F.—a thermometer being hung in the room especially for the purpose of recording the temperature. If the weather is cold, some means of heating will be required, preferably a large open fire which does not smoke, as, in addition to the heat, a means of ventilation is thus provided through the draught up the chimney.

Good ventilation of a room is very important and necessary for the sick, and the air should never be allowed to get stuffy or stale. To provide for fresh air and at the same time avoid creating a draught, as would be the case if a window were simply left open, a board about four inches high and of a length corresponding to the width of the window is placed under the lower sash. Fresh air will then circulate into the room between the lower and upper sashes.

**The bed** should be narrow—about three feet wide—easily accessible from both sides, and out of any draught. A clean hair mattress is preferable. Avoid soft feather beds.

The bed is made up as follows: A sheet is first smoothly spread over the mattress and is well tucked in on all sides. If there is any liability of discharges from wounds or moisture from wet dressings soaking into the mattress, a rubber sheeting or oilcloth should be applied over the under sheet as a protection. The four corners of this protecting sheet should be pinned to the mattress to prevent wrinkling. This should be covered by a draw-sheet. The draw-sheet is made by

folding an ordinary cotton sheet in half and laying it across the bed so that it reaches from just below the patient's shoulders to his knees, covering the rubber protection by about six inches above and below. The excess of draw-sheet is tightly tucked in under the mattress at the sides.

As a covering for the patient an upper sheet is provided, and is well tucked in at the bottom, and over this are placed one or more blankets, depending upon the season of the year.

**The "Fracture Bed."**—The bed in which a patient with a fractured limb is to remain must be fairly narrow, as with a

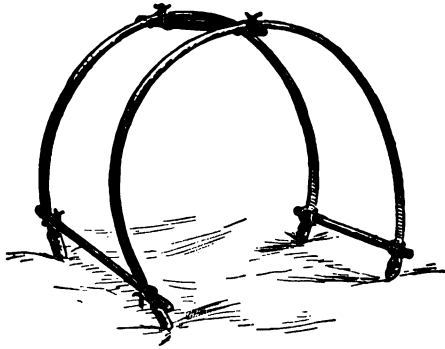


FIG. 241.—Cradle to keep bedclothes from a fractured leg, made from two barrel hoops (Scudder).

very wide bed it will be impossible to move or properly attend to him. Have the bed in such a position that it will be accessible from each side.

The mattress should be firm and flat, with no possibility of sagging, yet at the same time smooth and elastic. A hair mattress, or a wire mattress covered with several thicknesses of blanket is preferable. Never use a feather bed or feather mattress. An ordinary iron bed with springs is apt to sag too much. To avoid this, some boards should be placed between the springs and mattress.

For fractures of the lower extremity the foot of the bed should be raised a few inches to prevent the weight of the body

pressing down upon the broken fragments. A couple of wooden blocks inserted under the legs of the bed will accomplish this. It is also well to rig up some sort of an apparatus at the foot of the bed to take the weight of the bedclothes from the injured limb. Two narrow boards, fastened at their ends to form a right angle, with the long arm secured to the foot of the bedstead and the short arm pointing toward the patient, a cradle, or, if the bed is narrow, half of a barrel hoop made secure at each end to the sides of the bed, will answer.

**To Undress an Injured Person.**—Before putting an injured person to bed all the clothing should be *carefully* removed. First remove the shoes. In doing this it is best to remove the laces entirely so that the shoes will slip off without necessitating the employment of any force. If the extremity be injured, care should be taken to have the leg firmly supported by an assistant while this is being done. The stockings may be gently pulled off or they can be first cut down the sides and then removed. In taking off trousers or skirts the patient's pelvis will have to be slightly raised by an assistant until these garments are withdrawn below the buttocks. Underclothing is removed in the same manner. The patient's body below the hips should then be covered by a blanket while the upper garments are removed.

If an upper or lower extremity be fractured or otherwise injured, the garments should be removed from the sound side first and then *very carefully* from the injured limb, cutting the clothing off the injured side if any difficulty is experienced. If care be taken to cut along the seams, seldom any damage is done to a garment that cannot later be repaired by sewing. *Do not hesitate, however, to destroy a garment if in so doing the sufferer can be saved any unnecessary pain.*

In removing clothing from a burned person, it should be remembered that the clothing is apt to stick to the injured surfaces, so that the loose portions should be cut away, parts which remain fast being softened with oil or warm water and then carefully removed.

**To Lift an Injured Person into Bed.**—The methods by which this may be accomplished have been already described (see page 322).

**To Change the Bedclothes with the Patient in Bed.**—All the fresh bedclothing should be previously warmed and in readiness. The patient is then rolled over to one side of the bed, and the draw-sheet is loosened from the opposite side and is rolled up toward the patient until it rests close against his back.



FIG. 242.—Method of changing the draw-sheet by rolling the patient upon the side and then back to the dorsal recumbent position (Ashton).

The fresh draw-sheet is rolled up lengthwise as far as its center, and this rolled-up portion is placed against the rolled-up portion of the sheet that is being taken off, the unrolled portion covering that side of the bed from which the old draw-sheet has been removed (Fig. 242). The rolled-up ends of these two draw-sheets are then pushed well under the patient's back, and the patient is gently rolled back upon the new sheet to the opposite side of the bed. The soiled sheet can then be

easily drawn off. The rolled-up portion of the new sheet is finally smoothed out and its four corners pinned to the under sheet and mattress. The draw-sheet, rubber protective, and under sheet may, when necessary, all be changed at once by this method.

In order to change the upper clothing without exposing the patient, the upper sheet and one blanket are left in place after having been freed from the foot of the bed and over this is laid the new sheet covered by a blanket. The soiled sheet and the blanket covering it are then carefully pulled out from beneath the new sheet and blanket without disturbing these latter.

**Preparations for an Operation.**—Frequently, in an emergency, operations have to be performed on very short notice, and much assistance can be rendered the surgeon if there is some one about who can direct the necessary preparations of the room, etc.

Procure a room *with plenty of light*—if possible near the room to be afterward occupied by the patient, and with a bath room accessible. Have all the superfluous furniture, curtains, hangings, and carpets removed, and the room cleaned, if there is time. Large pieces of furniture too heavy to be removed may be covered by sheets. If time is of prime importance, simply protect the carpet from soiling by oilcloth, rubber sheeting, tarred paper, or newspapers. The room should be well heated (temperature of 75° F.), as the patient may be more or less exposed during the operation.

For an operating table nothing answers better than a large, strong, kitchen table. In its absence two small tables may be placed together, or an ironing board or two leaves of a dining-room table laid on the back of three *strong* chairs will answer. The table should first be covered with a blanket, then a rubber sheet or oilcloth, and finally a clean sheet. One or two small tables should be provided for instruments, solutions, etc. Flat-bottomed chairs will answer if tables are not available.

Plenty of hot boiled water, cold water previously boiled for half an hour and allowed to cool, several large, clean pitchers,

three or four medium-sized pans, a large slop-pail, soap, hand-brush, safety-pins, clean towels, and sheets should be also provided. The basins, pitchers, etc., in which the water is to be placed should be sterilized by boiling for half an hour in an ordinary wash boiler.

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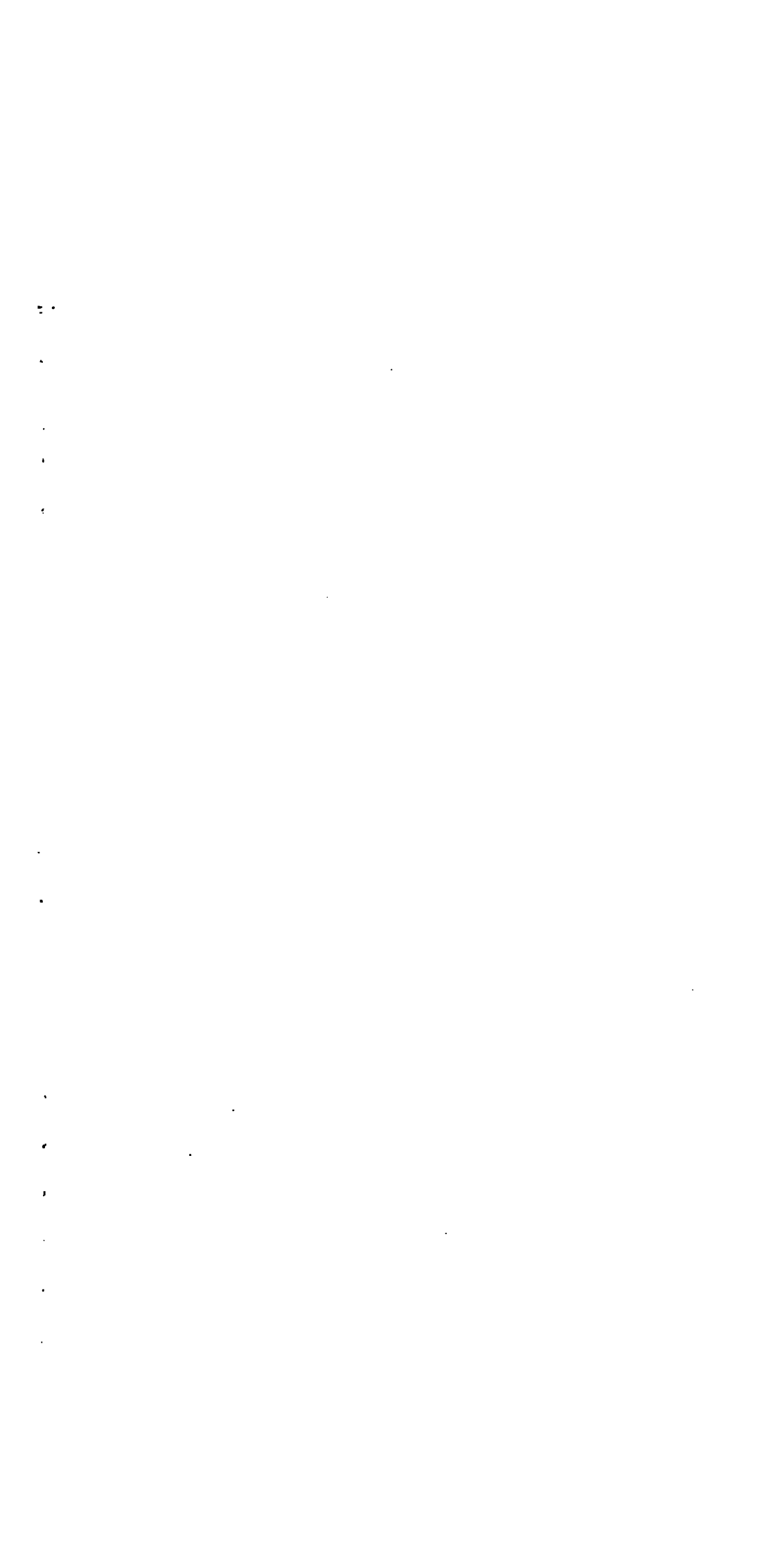
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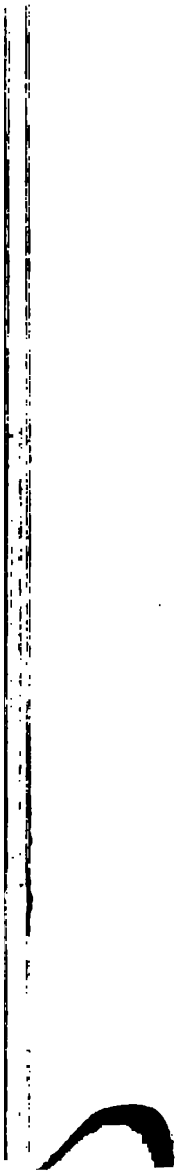
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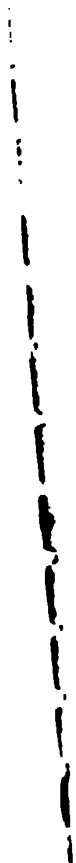
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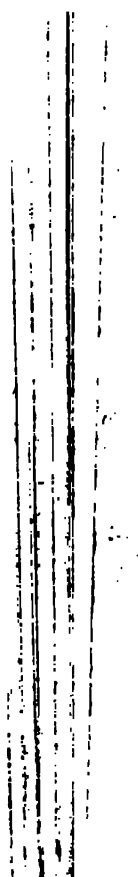
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